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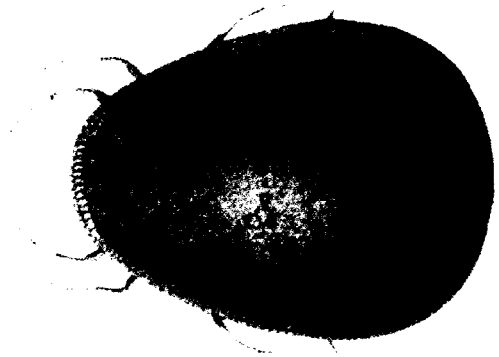
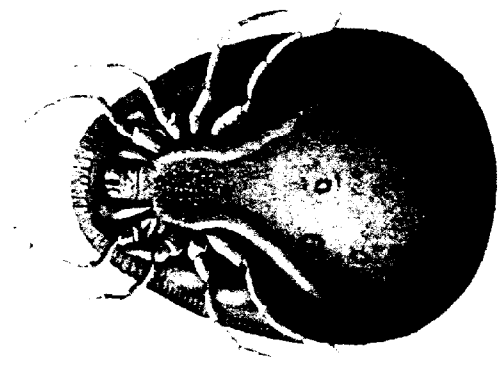
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CONTENTS.

SPIROCHETOSIS IN FOWLS (THE FOWL TICK) (WITH PLATE XL)	<i>Colonel H. A. Pease,</i> <i>C.I.E., I.C.V.D.</i>	309
MANAGEMENT OF EXPERIMENT STATIONS IN INDIA	<i>B. P. Standen, C.I.E.,</i> <i>I.C.S.</i>	323
REAPING MACHINES FOR WHEAT IN THE PUNJAB (WITH PLATE XLII)	<i>S. Mangtani, M.A.,</i> <i>B.Sc.</i>	327
SOME FIBRE PLANTS OF UPPER BERMA WITH PLATES XLIII AND XLIII	<i>John Auer, B.A.,</i> <i>B.S.</i>	333
THE TRANSPLANTING OF RICE IN ORISSA-GARH (WITH PLATES XLIV TO XLVII)	<i>D. Choudhury, M.A.,</i> <i>B.Sc.</i>	338
RICE CULTIVATION IN LOWER BERMA (WITH PLATES XLVIII TO LII)	<i>A. M. Kanna, M.A.,</i> <i>B.Sc.</i>	357
THE CULTIVATION OF TAPIOCA IN TRAVANCORE	<i>E. Panambalam Pillay</i>	366
NOTES		369
REVIEWS		392
LIST OF AGRICULTURAL PUBLICATIONS IN INDIA DURING 1907-08		395

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PLATE XL.



SPIROCHÆTOSIS IN FOWLS DUE TO THE FOWL TICK (*ARGAS PERSICUS*).

By COLONEL H. T. PEASE, C.I.E., L.C.V.D.,

Inspector General, Civil Veterinary Department

Many poultry owners in various parts of India must have been greatly annoyed from time to time by the serious loss of valuable fowls which have been swept off in the course of a few days by an epidemic which has, probably, generally been thought to be a form of fowl cholera.

I have often seen the whole of the poultry on a run thus carried off, and before it became the custom to make careful blood examinations of all animals suffering from obscure diseases, have been led by the clinical symptoms to diagnose the disease as cholera. In the year 1900, however, Conductor Dare of the Supply and Transport Department at Mian Mir, to whom I had lent a microscope for the purpose of diagnosing surra in camels, had the curiosity to examine the blood of some ducks which were dying off rapidly from an obscure malady. To his great surprise he found the blood swarming with a peculiar organism, and on his bringing some in to me, I was able to ascertain that they were spirochaetes. Since that time, the disease has frequently been met with in the Punjab and short notes on the subject have been published in the *British Medical Journal* and *Indian Medical Gazette* as to its occurrence in Central India, by F. Reaney, I.M.S.

A short note on the occurrence of the disease in the Punjab was published in the January number of this year's *Journal of Tropical Veterinary Science* by Mr. Montgomery.

As the disease is an important one from the point of view of the poultry keeper, I propose in the following short note to

give a *résumé* of what is already known of the subject, in the hope that by presenting it in a handy form, it may prove of use to poultry owners. For this purpose, I shall quote very freely from papers which have already been published in other countries, and especially Marchoux and Salembini's note in the *Annales de l'Institut Pasteur*, t. xvii, No. 9, pp. 568-580, in regard to the disease itself, as well as from the excellent article by Lounsbury on the Fowl tick, which was published in the *Agricultural Journal of the Cape of Good Hope* in September 1903.

How the disease commences.—The disease generally follows the introduction of new birds into an infected area. It appears to be probable that birds kept in an infected area acquire immunity owing to their having been attacked and recovering. It has been noticed, however, that when new clean birds are introduced on to the run, they may become infected at once and commence to die, and that in such cases, some of the birds, which previously were apparently immune, became attacked and died. Either the immunity was therefore not very strong or lasting or the "spirochæte" increased in virulency by being passed through the new fowls. Montgomery thinks that age carries with it a certain amount of immunity even when the fowls come from non-tick-infected districts. It certainly does in tick-infected areas.

The way in which an outbreak of the disease usually occurs is that birds are brought into a run which may have had no chickens on it for some time, or where chickens already exist. In a few days they are covered with larval ticks resembling lice, and are noticed to be sick.

Cause of the disease.—The cause of the disease is the presence in the blood of a peculiar fine spiral thread-like body, microscopical in size, a good idea of a highly magnified specimen of which may be obtained from the illustrations here given.

Symptoms produced.—It generally appears in an epidemic form, a number of fowls being attacked. The first intimation of the occurrence of the disease is very often the sudden death of a few fowls. More commonly, however, the first symptoms

shown are diarrhoea, loss of appetite, somnolence, the feathers erected and the comb pale. The fowl no longer perches, and as the disease progresses it lies down, the head, which it cannot raise, or place under the wing, resting on the ground. Death generally occurs suddenly in convulsions.

At other times, the disease takes on a more chronic form and the fowl, after apparent recovery, becomes again dull and remains crouching on the ground, the feet being paralysed.

Some days later, paralysis reaches the wings, the fowl becomes very thin and dies cachectic in 8 to 15 days.

At other times, recovery may take place after the first attack and more rarely also after an attack of paralysis has taken place.

If the temperature be taken, it will be seen to follow a characteristic curve. It is as much as 107° to 109° F., and remains in the neighbourhood of this during the four or five days of the first stage, when it falls, soon returning to normal. When the fowl is dying, it generally falls below normal.

If the bird be examined after death in the first stage, the spleen will be found to be about three times the normal size and the liver also will be greatly enlarged. The other organs are not much changed. The heart blood remains fluid and dark red in colour.

If the blood be examined microscopically during the first period of the disease, *i.e.* whilst the temperature is raised during the first four or five days, the "spirochaete," the organism above-mentioned, will be found in it.

The following description of what occurs in a healthy susceptible fowl, when a little blood containing the organism taken from a diseased fowl is injected under the skin, is useful as showing the course which the disease runs.

Some few hours after the injection is made, the temperature rises to 107° or 108° F. The next day diarrhoea appears, and the chicken is dull and does not feed, the temperature being 109° F., or even more. After 24 hours, a microscopic examination

will reveal the presence of a few "spirochaetes" in the blood.

The temperature remains in the neighbourhood of 109° F., for three or four days, then it falls below 105° F., and sometimes to 104° F.

The "spirochaetes" have been constantly increasing in numbers, which may be very considerable. The temperature falls when the quantity of parasites has reached its maximum in the blood.

These "spirochaetes" are at first few and isolated, and later unite, forming loose masses which later on become compact, forming large groups. When these masses form, the crisis occurs. In the acute or severe form they precede death by a very short time.

Signs of recovery.—If the fowl be going to recover, the general condition improves, the loss of weight stops, the temperature rises to normal, and perfect health soon returns. It takes about a fortnight, however, for the fowl to regain its original weight. If the animal has been partially paralysed, recovery takes much longer.

Signs of the chronic form.—When the disease assumes the chronic type, the weight continues to fall, the temperature remains below normal, paralysis supervenes and death soon occurs in probably 12 to 15 days.

Immunity. A fowl once recovered from the disease possesses absolute immunity, and this is early established. It appears possible to confer immunity, by means of the serum from infected fowls. Fowls kept on an infected run apparently become immune if they survive, but at the same time, apparently immune birds will succumb when infection has again been started by new birds; possibly the disease may become intensified by the passage of the spirochaete through susceptible birds.

Susceptible animals.—When the disease occurs on a run the other fowls generally take it, but some may escape. Young chickens are susceptible to both the natural and inoculated

disease. Their general condition, however, appears better during the course of the disease, and they may run about and feed till death.



FIG. 4. The fowl tick (*Argas persicus*) under a piece of bark (after Lounsbury).

The goose is very sensitive as is also the duck and guinea-fowl. The pigeon shows some dullness after inoculation, but no organisms in the blood. The dove and sparrow also take it.

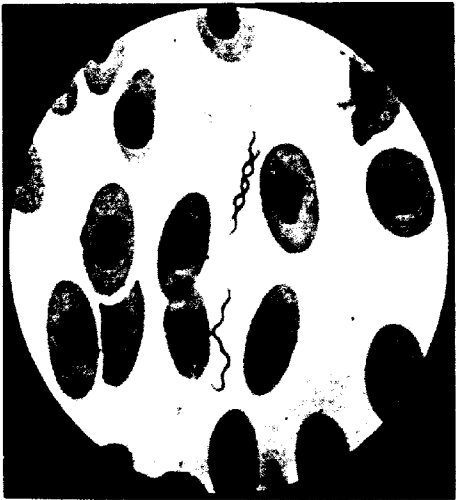


FIG. 5. *Quercus laevis* and *Quercus macrocarpa* in the blood of blood-sucking Mosquitoes, showing clumping $\times 1000$.

Well-bred English fowls are, as a rule, very susceptible, and I have seen the whole of them taken off a run where the country fowls remained apparently healthy.

How the disease spreads.—The question of how the natural infection of fowls takes place and how the disease spreads so rapidly in a fowl run, naturally interested Marchoux and Salembini, and it suggested itself to them that probably a fowl parasite acted as an intermediate host to the spirillum. They therefore proceeded to ascertain by experiment whether this is the case. On examining the infected runs, they found, hidden under the wood or in the interstices of planks, a great number of a peculiar form of ticks. These have somewhat the appearance of a woodlouse. They belong to the family *Argasidae*. These ticks, the Indian variety of which is named *Argas persicus*, (Plate XL) are pretty widely distributed in India and are the common fowl ticks of the country. The accompanying illustrations will give a very good idea of their appearance.

Marchoux and Salembini ascertained experimentally by allowing the ticks to bite first diseased, and later on healthy, fowls, that the latter were infected in this way. The following experiment may be quoted:

In a glass vessel covered by metallic wire a fowl No. 1 and a few ticks, which had been allowed to feed on an infected fowl, were placed.

In a wooden case, one wall of which was made of brass wire, they placed a healthy fowl No. 2 and an infected fowl.

Result.—Healthy fowl No. 1 became infected in nine days, and No. 2 in four days.

Similar experiments were repeated several times with the same results, so that it has been satisfactorily demonstrated that ticks are capable of transmitting the disease, and that they do so in natural infection.

It has also been proved that ticks, which have fed on a fowl infected with spirochaetosis, have been proved to be capable of transmitting the disease to healthy fowls five months after biting the sick one. It is quite possible that the ticks preserve the spirilla

for a still longer period, and hence it is that they are such important agents in the cause of outbreaks of the disease. It is a curious fact that it is necessary to keep the ticks at a suitable temperature (about 30 to 35 F.), after they have been fed on blood containing the spirochaetes. In ticks kept at from 58 to 68 F. after feeding, the spirochaetes seem to disappear after three or four days. If kept at a low temperature they may bite fowls repeatedly without infecting the birds, although the ticks harbour the parasites. Borrel and Marchoux found that ticks could be maintained three months at a low temperature without being infective, but on placing them at 95° F., the spirochaetes reappeared in the ticks, and the latter again became infective. These facts are interesting as showing the influence of climate and season on the prevalence of the disease. Once they have bitten infected birds they are capable of carrying the infective parasite in their bodies for a very long time, and when the conditions become favourable, of infecting clean birds brought on to the run months afterwards, and giving rise to a fresh epidemic. The spirochaete are parasitic in the tick as well as in the fowl, the parasites passing to the offspring of infected adult ticks. It has long been known that the fowl tick does cause heavy losses in poultry, but the exact method by which this occurred, was not generally known. We are now aware of the cause of the losses and the means by which they are brought about.

The fowl tick: Argas persicus.—The bodies of these ticks are usually oval, flat and thin, much like that of a bed bug. They attack poultry by night and are found in crevices of the walls, boards, etc., in fowl houses, by day. Both male and female are much alike, excepting that the females after feeding increase in size. The only sure way of distinguishing the male from the female is by noting the shape of the genital orifice, which is situated just behind the mouth parts, which are situated beneath, on the under side of the front of the body, and are not visible from above: that of the male is relatively inconspicuous and is surrounded by an oval ring: that of the female appears as a transverse slit. The ticks measure, when adult, a quarter of an

inch long and about a sixth of an inch broad. Females which have fed may measure from two-fifths to half an inch long and proportionately wide.

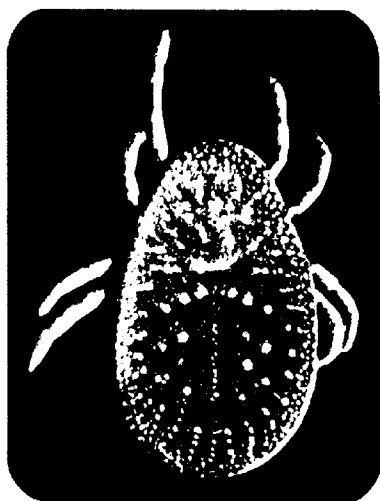


FIG. 6. The feed tick, *Ixodes persulcatus*, after Leansbury.

The surface of the skin is thrown into folds when the animal is not fed, but becomes smooth after a meal. The color before a feed is chocolate brown, except at the margin, which is always pale brown. Just after a feed the general surface is a ruddy blue-black, and a few days later the ruddiness disappears. The legs are almost colorless.

On the upper surface of the body a large number of depressed discs are noticed, the numbers and arrangement of which vary with individual specimens. There are three constantly large ones arranged in the form of a triangle on each side of the middle of the body, a little less than half way from the rear margin, about ten other relatively large ones in front of these, a row of small ones from between the two triangles to the rear margin, and shorter rows up each side directed from the margin towards the middle. Discs of similar appearance occur on the under surface.

The mouth parts lie in front of and between the front legs. The rostrum is a short club, studded with four rows of recurved spines. It is through this organ the blood is drawn. The mandibles which are used to cut a hole through the skin for the entrance of the rostrum lie side by side above it. They can be extended and are furnished at the tip with a cluster of hard, hook-like processes which are capable of independent movement. The tick uses them for clinging to the flesh. The ticks have no eyes and prefer darkness, avoiding the light.

Life history of the tick.—Lounsbury has carefully traced the life history of the *Aegys persicus*. Unlike the female of the Ixodid tick which dies after laying her eggs, the female of *Aegys persicus* lives on and may feed and lay other batches of eggs afterwards: egg-laying in warm weather generally begins about a week after feeding. The eggs are laid in the crevices in which the ticks hide during the daytime in the walls, cracks between boards or under the bark of a post. The eggs are round and brown, the number laid each time varying from about 20 to 100. They begin to hatch out in about three weeks.

The larva.—When newly hatched, it is an almost colorless six-legged creature, with very long legs. It is about a thirtieth of an inch in length. It feeds as soon as it gets on to the fowl, and generally drops off on the fifth day, but some may remain on up to the ninth or tenth day. When fully engorged, it is a deep purplish black, and measures about a tenth of an inch in diameter. Just before leaving the fowl, it elongates and flattens, assuming the shape and form of a miniature of the adult, which better fits it for crawling and concealing itself. It now avoids the light, generally getting into some crack where it rests until moulting occurs, and it arrives at the second stage, when it has four pairs of legs and the breathing orifices appear. It again feeds at night, the meal being quickly taken, and seeks concealment, where in about a fortnight a second moult takes place and the third stage is reached. It again feeds for the third time and the measures about a quarter of an inch long. It again hides for

few weeks, and a third moult takes place, when the tick has reached its adult stage.

In the adult stage the ticks feed, at night about once a month in the hot weather when they can, the female increasing in size whilst the male remains about the same size. After each feed the female lays eggs. When the weather is cold, the periods between the feeds increase. In ticks kept by Lounsbury in confinement it was noticed that few eggs were laid after the fourth feeding of the adult, and fewer after the fifth and sixth. Some of his adults fed seven times.

Longevity. The fowl tick at all stages is able to exist many weeks without food or drink in hot weather, but in the early stages has not so much vitality as in the later adult stage. No larvae survived more than two months, and no nymphs beyond four months, but adults were still vigorous after a year. Lounsbury says that it is quite probable that all stages of the tick will survive without food for much longer periods than those mentioned under natural conditions in disused fowl houses. He has found larvae abundant in a fowl house five months after the last fowls had been removed; and he found numerous nymphs and adults in an outbuilding to which no fowl has had access for fifteen months.

Getting rid of the tick. This is by no means an easy matter, as Lounsbury says. From a consideration of the habits of the fowl tick it will be apparent that it may be combated in several ways: (1) by seeking them on the walls and roosts at night when they come out to feed; (2) by destroying them in their hiding places with a contact insecticide; (3) by destroying the larvae before they leave the fowls; (4) by so supporting the roosts that the ticks cannot reach the fowls. The first measure is impracticable. The second would do if it could be thoroughly carried out, but this is generally not possible in Indian fowl houses owing to their construction and to the difficulty in killing the ticks by means of any insecticide. The third is also not easy, although often recommended in Australian journals. It is perhaps better to try a combination of methods. Lounsbury

quoting a plan adopted in Grahamstown, which proved successful, says :—

“ The plan adopted by me to get rid of the fowl tick was to burn all the old roosts and nests. Then I had the wooden walls of the fowl house well brushed over with hot coal tar. I then procured four new roosts of clean deal with the edges planed off and slung them with wire from the roof, hammock fashion, two lengthwise and two across at each end. Thus no roost touches the sides or walls of the house. The object of supporting the roosts by wires in this way is to preserve the fowls from being pestered at night by the ticks which harbour in the crevices of the walls. In the day time the fowls can protect themselves if they have a good run. On no account should poles with bark on be used for roosts, as the ticks will hide under any loose pieces. If any ticks make their appearance in the nests, I make free use of paraffin applied with a brush, and this is effective in destroying them. The floor is regularly swept clean and sprinkled with wood-ashes or lime. Since adopting these measures, about two years ago, I have not lost a fowl by the pest. I may add that some of my neighbours have cleared their fowl houses by the frequent use of strong solution of some sheep dip applied with a spray pump or a garden pump.”

I should recommend scraping and reeeping the walls and covering all the inside with a thick coating of hot coal tar, carefully filling up all cracks in woodwork, etc., and slinging perches as above recommended, cleanliness of the floor and keeping it sprinkled with wood ashes. If not too numerous, fowls covered with larvæ may be freed from them.

To destroy larval ticks on poultry they may be brushed over with paraffin, which destroys them, but also rather scalds the skin of the fowl. Sweet oil brushed over the fowl acts satisfactorily. Lately, Bevan states that in Africa the practice of dipping poultry in warm solutions of some of the common sheep dips has found favour, and very excellent results have followed the use of a warm solution of Cooper's dip of rather weaker strength than the mixture used for sheep. The immediate effect of immersing fowls in these dips is sometimes rather alarming, the birds lying

Construction of a new fowl house in a tick area.

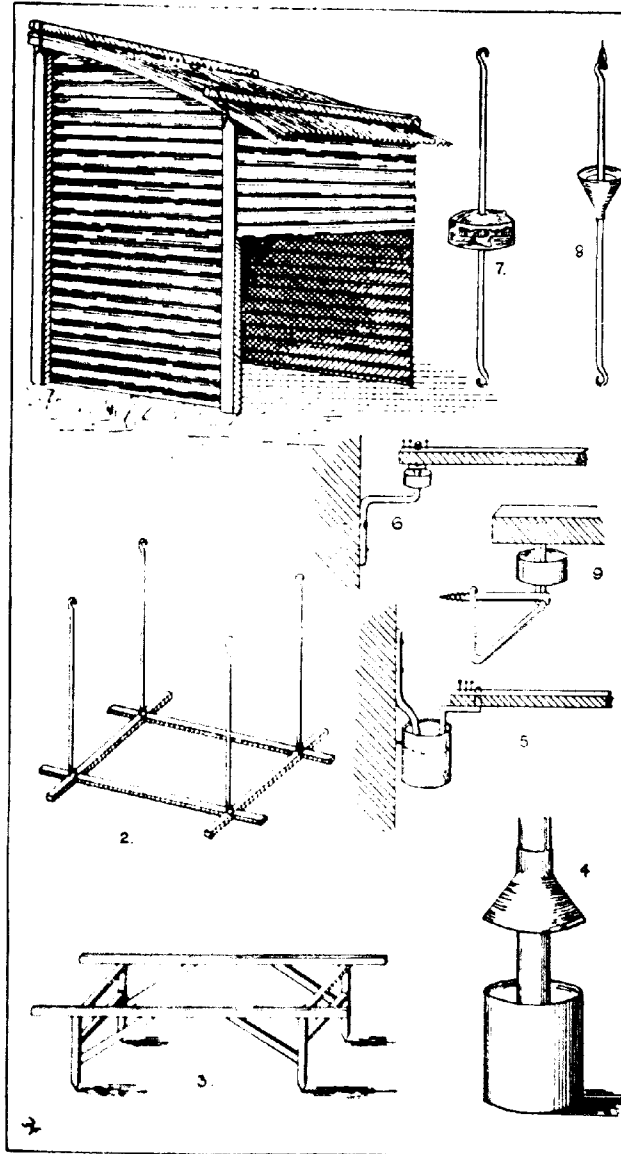


FIG. 1.--1. Tick-proof Fowl House with woodwork outside. 2. One level roost to show how supported by rods or wires. 3. One level roost supported from floor. 4. Suggestion for insulating leg of No. 3. 5 and 6. Methods of insulating roosts by tick proof wall brackets. 7 and 8. Insulation devices for rods and wires; in 7 which is dust-proof (figured with part of side cut away to show oil furrow) the oil is poured in through the aperture at the top. 9. Tick-proof roost bracket procurable from dealers in poultry supplies. (After Lounsbery.)

on their sides as if about to die ; they quickly recover, however, and if care is taken, fatalities are rare. The natives of India use " Bindal " in decoction, 2 ounces to the quart of water. The fowls are dipped in this, but it is better to apply it with a brush.

It is important to avoid the introduction of ticks into runs which are free, and for this purpose it is very advisable to isolate new fowls for ten days and to destroy any ticks found on them before allowing them to go into the run. The boxes in which they are isolated should be thoroughly disinfected to destroy the larvæ which will leave the fowl in this time.

Lounsbury gives the following advice and the accompanying diagrams on the above subject. The one great aim is to have the building as nearly tick-proof as possible. Corrugated iron is one of the best building materials for this purpose. A design with all the wood work outside was figured by Mr. Alex. Crawford, in the Journal of the Western Australia Department of Agriculture for June 1902 (see Fig. 7). Four upright posts support the structure. Strips of corrugated iron placed crosswise form the front, back and sides. Those forming the ends are screwed to the inside of the posts, and those forming the back and front to the outsides. The lower half of the front is left open, but a sheet of iron, hinged at the upper side to admit of closing it at night could be easily added ; likewise a sheet at the back could be made to open outwards on hinges, so that the egg boxes could be inspected from without. The sheets to form the roof are laid in position, and then held down by two battens, one at the back and the other at the front, bound by wire to the corner uprights. The outsides of the house should be painted with refrigerating white paint, and the inside with tar. Great cleanliness of the house and run is necessary.

Treatment of the sick.—There is no reliable treatment.

MANAGEMENT OF EXPERIMENT STATIONS IN INDIA.

By B. P. STANDEN, C.I.E., I.C.S.,

Director of Agriculture, Central Provinces.

This article deals briefly with one feature in the management of experiment stations of some importance from several points of view. It is scarcely necessary to say that the object of an experiment station is not to make a profit, but to solve certain problems of sufficient importance to warrant the expenditure of public money. But the influence of this principle, coupled with a praiseworthy desire that the appearance of the station should be worthy of its owner, has caused us to forget that it is possible to pay too little attention to earnings and even to prejudice the results of the experiment work by unnecessary elaboration of arrangements, and to ignore that what is applicable to an establishment intended for experiment only, does not necessarily apply to farms used for other purposes besides the investigation of agricultural problems. Many, perhaps the majority of the experiment stations in India, comprise much larger areas than are required for the conduct of the experiments: they usually cover 150 or 200 acres, of which only some 15 or 20 acres are used for experimental purposes, the remainder of the area growing good varieties of crops for seed. Such a station is, in fact, a highly cultivated farm, of which a small part is set aside for purposes not directly profitable, and which is managed by a staff which is more expensive than would be required for a farm of similar size cultivated for profit only. The station is provided with good buildings, comprising quarters for the establishment, seed store, barns for storing fodder, and cattle sheds with special arrangements for collecting and storing the urine and dung of the cattle.

The cattle are the best to be had. The first thing which strikes a cultivator who visits a station fitted up in this way is the enormous cost of the arrangements; he at once draws the conclusion that, if the crops are better than he can raise, it is due to lavish expenditure beyond his means. He sometimes doubts whether even the fine crops which he sees on the ground will pay for the expenditure which he incurs, and if he asks for information, he is told that there is a large loss on the station and that it is not intended that it should pay. This sends him away with a very natural, though a wrong, idea of the value of the work that is being done. This idea may be modified in particulars by demonstration of novel operations in his own village under normal conditions. Such demonstrations may be, and indeed have been, effective so far as regards particular operations, but they do not suffice to remove the impression produced by a visit to the station that high farming on the whole is not profitable. This is unfortunate because, although very much can be done to increase the produce of the country by the introduction of new methods, the more thorough application of practices now in common use is also of the utmost importance, and it should be our object to stimulate the cultivator by showing him that the mere exercise of the utmost care and diligence in all ordinary operations is productive of great advantage. There is even a danger that the perfection of the buildings, stock, &c., may diminish the practical value of the experimental work. For instance, it will be admitted that we are not working for the benefit of farmers who can afford to stand their cattle on stone floors with channels to lead off the urine into brick lined and roofed pits in which the dung and refuse is stored. Yet our experiments are conducted only with manure produced under these conditions. The results of similar experiments carried out under conditions attainable by any good cultivator in India would certainly be different, and might conceivably affect the conclusions drawn.

The proposition which I would put forward is that, in designing an experiment station of the sort described above, it

should be borne in mind that after making allowance for staff and buildings required for the experimental part of the area, the value of the produce of such parts of the farm as are not used for experiment should be sufficient to cover the cost of management and cultivation, including interest and depreciation on cost of buildings and to yield a substantial profit besides. It is, of course, understood that the land would not be used for crops which for any reason could not be profitably grown on a large scale in the locality for the benefit of which the station is established. Since a part of the produce would often be distributed gratis, the actual cash receipts would not necessarily reach this figure. The acceptance of this principle would, no doubt, result in less perfect buildings than would be usually erected in Europe, by a rich landlord, but it must be recognised that agriculture cannot give the same returns in India as in Europe, because cattle are not kept for food, and the quantity of farm yard manure available must be much less, and is as a matter of fact extremely limited.

The accounts should be so drawn up as to show the amount of the expenditure which may fairly be taken against the non-experimental area and the value of the produce of that area. The division of the cost of superior establishment and buildings between experimental and non-experimental areas would be partly arbitrary, but the result would be sufficiently correct to afford an indication of the extent to which the principle stated in the last paragraph is being observed.

Accounts are not now kept so as to distinguish between expenditure debitable to experimental and non-experimental cultivation, but the deficit is in some cases at least so large as to leave no doubt that the receipts for the latter area are never likely to provide a margin of profit on the expenditure. In the most favourable instance known to me, a gross return of Rs. 60 per acre would be necessary on an area of 100 acres to cover the cost of cultivation and interest and depreciation. The present gross return is only Rs. 34 per acre. But although it may not be possible in all cases that the receipts should yield a fair profit on the sum spent in establishing the non-experimental part of

the station, it is at least certain that if the principle advocated in this note were definitely recognised, the net expenditure on the department could be materially reduced. If experiment stations can be safely managed on these lines without risk of sacrificing the objects of the station to profit-making, there seems as good reason for insisting on the production of a profit from the non-experimental area as on the production of useful results from the experimental series.

Note.—Mr. Standen's article raises questions which, in the interest of the Agricultural Department, I consider, are of very substantial importance. I should like criticisms, which I will gladly publish in the "Journal."—Editor.

REAPING MACHINES FOR WHEAT IN THE PUNJAB.

BY S. MILLIGAN, M.A., B.Sc.,

Deputy Director of Agriculture, Punjab.

LIKE all new countries, the Canal Colonies of the Punjab have suffered since their inception from a scarcity of labour. Cultivation has, hitherto, been extensive rather than intensive, at least judged from Indian standards; and while labour has been scarcely adequate for ordinary purposes, the pinch is severely felt at the wheat-harvest time, the floating population of casual labourers being quite insufficient for the requirements of the Colonies. This year, it is true, labour has been more plentiful than usual, but owing merely to the great shortage of the matured wheat area of the Province. For some years, the average daily rate of harvest labour has been not less than Re. 1 per man, payable in kind, and the cost of reaping Rs. 5 per "killa".

It would thus appear that there was a fair opening for reaping machines, provided that they could be properly worked in the somewhat diverse conditions of the irrigated fields of the cultivators. In the Canal Colonies, each field is exactly one killa in area or $1\frac{1}{2}$ acres, and is usually sub-divided for irrigation purposes into four or six parts by bands or "kiaris" as they are called. The small size of the fields entailing many "openings" and the obstructions offered by the "kiaris" summarise the chief difficulties in machine reaping. The hardness of the land, while it increases vibration, considerably diminishes the draught and enables two horse mowers and reapers to be drawn by moderately strong bullocks.

The question being of primary importance to the internal economy of the Canal Colonies has received the attention of the Agricultural Department for some years. There were really two main problems to solve.

1. The economic question as to whether the available labour supply would not be better employed in gathering and binding the crops cut by machines.

2. The selection of a suitable type of machine to overcome the difficulties above mentioned, simple enough to be managed by the ordinary zemindar and light enough in the draught for his ordinary bullocks. The Department having addressed itself to the question, several types of machines were put under trial; and while these trials were going on, observations were made as to the economic problem as to whether there was a chance of a reasonably good return on invested capital. Dealing with this point, it may be as well to mention that reaping in the Punjab usually means, in addition to the cutting of the corn, the binding of the cut crop into large bundles of about a maund (52 lbs.) each and the carrying of it to the threshing floor. The binding and removing of the crop is done by the reapers themselves, who stop cutting in the afternoon for the purpose. This practice had to be taken into consideration when making calculations as to the probable area which would be cut by a machine in the Districts, as it could not be hoped that the cultivators would at once abandon their traditional methods and adopt the more economic one of keeping all operations going at the same time. The following calculations, therefore, were based on that assumption. After some trials it was estimated that with a manual delivery reaper (the type finally chosen as being the simplest, lightest, and most suitable to local conditions), by employing a force of 8 men, 5 killas per day could be reasonably expected to be cut, bound and removed by ordinary cultivators, and that the extra labour employed in carrying out all operations at once would increase proportionally with the area cut. The saving in labour would, therefore, amount to the wages of $(5-1.6) = 3.4$ men per killa for all areas

cut. With an average of 14 days reaping, the annual area cut would amount to 70 killas. Annual expenses were estimated at Rs. 100 as under :—

	Rs.
Interest and depreciation on Rs. 250 at 30%	75
Repairs " " " "	15
Oil Rs. 5. Extra food for cattle Rs. 5.	10
	<hr/> 100

In order that the machine should pay its way, the saving in labour would thus have to exceed Rs. 100 per annum, and this would depend on the daily rate of wages. The profit and loss would, therefore, be represented by the value of 'y' in the equation.

$$\begin{aligned} \text{Net gain, Killas, Min. Wages, Rs.} \\ y = (70 \times 3.4 \times X) - 100 \\ 238 X = 100 \text{ Rs.} \end{aligned}$$

where X equals the daily rate of wages in rupees. Giving X the values 0, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{1}{2}$, $\frac{3}{4}$, and 1 in succession, we have the following values of Y or the annual profit after deducting interest and depreciations.

Daily rate of labour in Rs. X	or in As.	Annual profit in Rs. Y
0	0	+100
$\frac{1}{4}$	4	+40.5
$\frac{5}{16}$	6.7	0
$\frac{1}{2}$	8	+19
$\frac{3}{4}$	12	+78.5
1	16.65	+138

It will be seen that machine cutting would begin to pay when labour exceeds 6.7as. per day, and that the profit rises to Rs. 138 for Re. 1 per day, a figure below which it very rarely falls.

An examination of the variations of the profit and loss account under different areas cut per season is useful and important; assuming that depreciation varies according to two factors, one half with the number of years in which the machine has been in use, and the other half directly with the actual area

cut, and taking Rs. 5 per killa as the average cost of reaping by sickle, the profit can be represented very nearly by the value of Y in the equation $Y = (2.48 X - 35)$. Giving X the value of 5, 10, etc., in succession, we have—

Acres cut annually, X	Profit and loss, Y
Rs.	Rs.
5	-22.6
10	-10.2
14.1	...
15	2.2
40	64.2
70	138.6
100	213
150	337
200	461

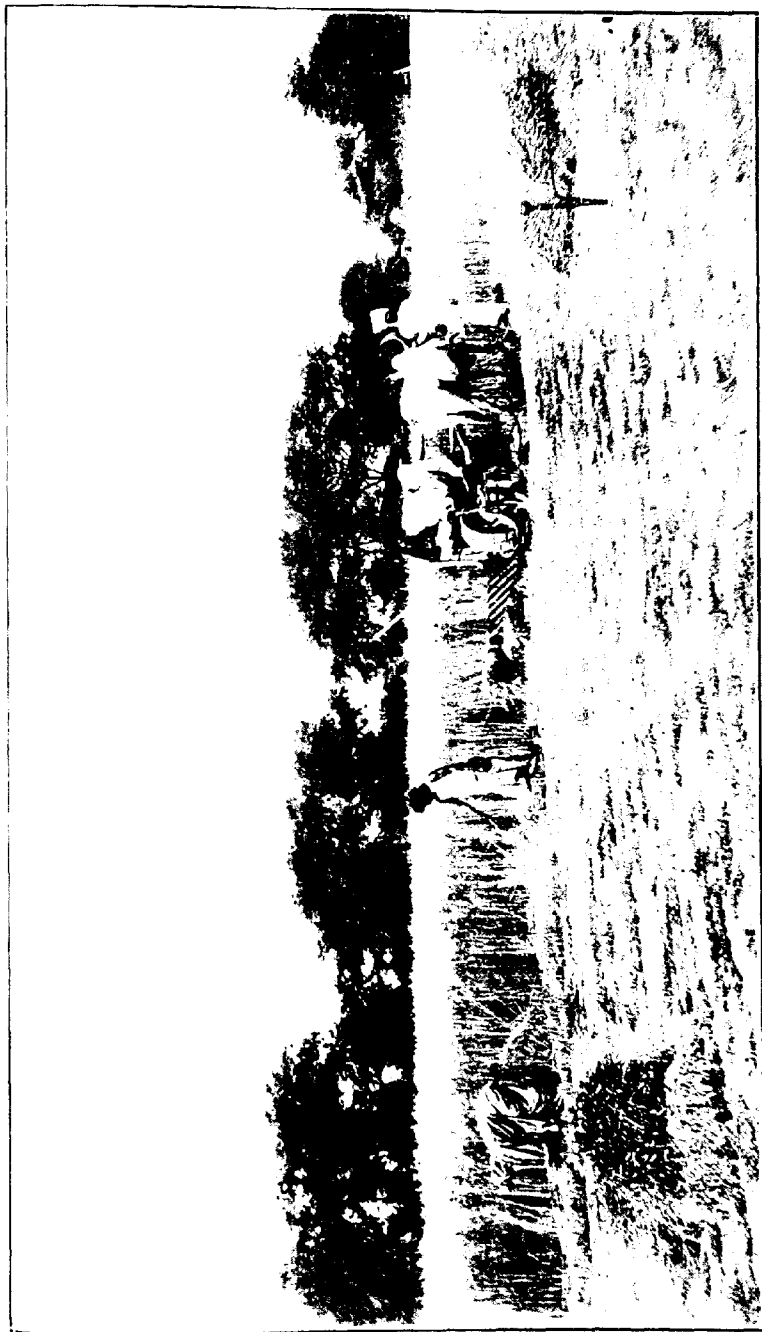
The following points may be noticed :—

Firstly.—That in ordinary years the machine will just begin to pay with an annual cutting of 14.1 acres. This is very important, as it would indicate that even in unfavourable years with lying crops there is not much fear of any man getting at least interest for his capital.

A more important point brought out is the great advantage of reaping large areas annually, while it is not to be expected that the ordinary zemindar owner of a machine will push its cutting capacity to its limits, the figures shown indicate a wide field for enterprising contractors. In the more protracted seasons, by proper organisation the figures 150 and 200 killas could be, I think, attained to. At any rate, the figures indicate the very great importance of the organisation of labour.

From the calculations given above, little doubt remained as to the economic value of reaping by machine even under the worst conditions, and the great possibilities under more favourable auspices. It only remained to obtain a suitable machine, and to see whether the average cultivator could work it successfully or not. After several trials, it was decided that a combined reaper and mower would prove the most reliable type as a pioneer machine. (Plate XLI.) The trials were watched with considerable interest by a few zemindars who were struck with the simplicity of the

PLATE XLI.



REAPING WHEAT, LYALLPUR, PUNJAB.

A. J. L.

manual delivery type, and orders for 22 of these machines were booked by private individuals for the harvest of 1908. Further indents for 30 more were sent in by District Boards and other bodies for demonstration purposes throughout the Province, the total thus amounting to 52, quite a sufficient number to give a fair indication as to whether the zemindar would be equal to the successful working of the innovation or not.

Prior to this year, several attempts had been made by private individuals to introduce reaping machines into the Colonies but these all ended in failure, mainly owing to the adoption of unsuitable types of machines and to want of perseverance. Preparations were made in good time by the Department to give some assistance to purchasers at the outset, and classes of practical instruction were instituted at Lyallpur before harvest time. Pamphlets giving directions for the use and care of machines were also circulated to purchasers; on account of the smallness of the Departmental staff, practical assistance during harvest time could only be given to a limited number of owners, and as the Lyallpur District contained all the private purchasers and by far the greater number of machines, it was decided to concentrate our efforts there. This course was justified by the results, as complete success attended the working of the machines in that District in spite of all difficulties. The machines did good work, proved to be of light enough draught for average bullocks, and, best of all, were after a few lessons understood by the zemindars themselves. The previous estimates for labour, etc., proved near the mark. The average area for the season worked out at a little over 68 killas or a little over 5 killas per day. The average saving in labour was nearly 33 men per killa as against an estimate of 34, the difference being due to bad organisation on the part of several users. Breakages were few, the cost of spare parts and repairs averaging Rs. 2 as against an estimate of Rs. 15, but of course the machines were new. The question of depreciation can only be satisfactorily settled after some years' experience, but all the Lyallpur District machines are in good order after the season's work.

The working of the machines in the other Districts was, on the whole, not so satisfactory, although some notable exceptions were recorded. The reasons are not far to seek. In the first place, the machines were used for demonstration only and no attempt was made to run them on commercial lines. Secondly, they were not bought by private individuals, and the first incentive to success, namely, profit, was absent. Again, there are many districts, especially those irrigated from wells, which are totally unfitted for machine reaping. Possibly, too, the personal help given at the outset by the Agricultural Staff in the Lyallpur District had not a little to do with the success attained there.

On the whole, the results are very encouraging, and it seems fairly well established that the adoption of machines of a suitable type will prove a success in the Canal Colonies. Considering the large areas under Canal irrigation, and the vast extension schemes projected by the Irrigation Department, there appears to be a very wide field for their use.

The Agricultural Department is making arrangements to establish an agency at Lyallpur for the sale, distribution and repair of machines, and will devote its attention towards effecting improvements in the machine itself and assisting in the education of zemindars in its proper use.

The great danger seems to lie in the introduction into the market of unsuitable types or machines of inferior workmanship, and local purchasers would be well advised to consult the Department before buying an unknown make of machine.

SOME FIBRE PLANTS OF UPPER BURMA.

By LEON AUBERT, B.A., F.R.S.,

Superintendent of Land Records, Burma.

FIBRE can be extracted, more or less, from a large variety of plants in Burma, but only a few are really valuable and of any use to the Burman agriculturist in the construction of his house or his carts, for repairs to his harrows or his ploughs, or for sale to his less industrious neighbours. Amongst these plants, *Hibiscus cannabinus* (in Burmese, *Chinabang*), an annual commonly cultivated in Upper Burma for its fibre, holds the first place and makes at the same time an excellent pot-herb, as the tender leaves and green capsules are eaten in curry. Sown at the beginning of the rains in small patches or mixed with other vegetables such as pumpkins, gourds, or beans, it is uprooted or cut down close to its root in November. The area under this crop in Upper Burma can be safely estimated at 10,000 or 12,000 acres. It is also cultivated, to a certain extent, in parts of Lower Burma, but it is not as common as in the Upper Province. This is really the principal fibre plant of Upper Burma, where *Crotalaria retusa* and *Crotalaria juncea* (*Paiksay*) are not grown, except on the banks of the Irrawaddy and Sittang Rivers. The latter is cultivated in Lower Burma, and the fibre is utilized for making fishing nets.

2. To extract the fibre of *Hibiscus cannabinus*, an incision is made all round the lower end of the stem of the grown up matured plant. The epidermis comes off readily, and the ligneous portion is thrown aside. Having separated the bark from the fibrous portion under it, the latter is dried in the sun for a couple of days and stored up. When required to be made into rope,

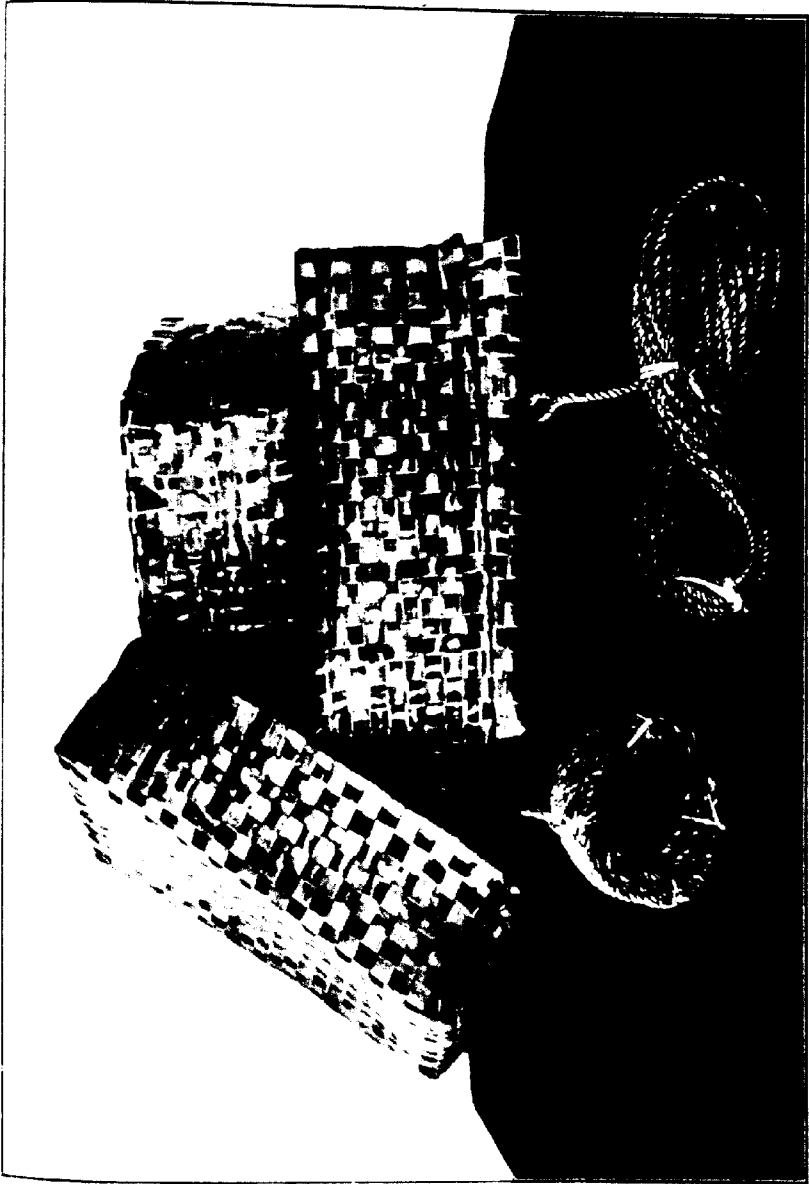
the fibrous mass is soaked for a week in water. At the end of that time, it is placed on a slab and beaten with a mallet to remove all the fleshy matter. A final washing leaves the pure fibre, which is placed in the sun, but not allowed to dry completely and is twisted into rope; if too dry, it should be moistened before twisting. Ropes can be made of any size and length required. An inferior kind of rope is made also with the epidermis which is not thrown aside, but utilized by agriculturists of the poorer class for binding the yokes of their ploughs and carts. (Plate XLII.)

Another hibiscus, *Hibiscus fereatus* (in Burmese, *Chin hwee ying*) grows wild. The fibre is sometimes extracted and treated in the manner described for *Hibiscus cannabinus*, but is not valued.

3. Though found in a wild state and common throughout the country, *Urena lobata* (in Burmese, *Ka shaw*) may well be mentioned here. The fibre is used to make ropes, especially in Lower Burma, and the plant could be cultivated easily. The method of extraction is the same as in the case of *Hibiscus cannabinus*, and more or less trouble is taken according to the kind of rope required.

4. *Bauhinia racemosa* (in Burmese, *Hpatubia*), a large jungle tree, also supplies the agriculturist with a useful fibre. The process employed in its extraction is very similar to that followed in the case of the *Hibiscus*. The rope made with the bark is generally used during the rainy season and is said to improve in tenacity when exposed to moisture or to the effects of wet weather. This *Bauhinia* is not cultivated.

5. Another fibre plant evidently introduced from India or imported by the Portuguese and cultivated in days gone by, is *Apre Vera Coz* (in Burmese, *Namat*). This *apre* is not now, in these days of cheap Manchester cotton fabrics, cultivated for its fibre, but is often grown round villages and burial grounds as a live-fence. (Plate XLIII.) The plant is said to flower only once and die. At that time a long ligneous stem 18 to 20 feet high shoots up from the middle



of the plant carrying large cymes of flowers. This plant, named by the residents Aloe, Indian Aloe, American Aloe (but not an aloe at all) yields a good fibre which is extracted and utilized for rope making by prison labour in several jails in Upper Burma. The process adopted here is the Indian method. The leaf is first beaten on a slab with a wooden mallet, soaked and washed in pure water, then beaten a second time and allowed to dry in the sun. After this, the dry fibrous mass is beaten a third time and made into rope.

The Burmese process, closely connected with the birth of the silk industry originally introduced into Burma from Aracan, Assam and China, is described by very old Burmians as follows:— About the year 1560 (1222 Burmese era) during the reign of King Mindon, a colony of Aracanese silk-weavers (*Kotho*) established themselves in one of the southern quarters of Mandalay (the Naddiye quarter) and began to weave silk fabrics for the King and well-to-do people. For the use of the lower classes, a cheaper quality was woven with a mixture of this *Agave* fibre extracted by the process described hereafter. Though simple and primitive, this excellent method yields a beautiful, soft, shiny fibre in every appearance similar to silk. The *Agave* leaves are buried in putrid mud such as the mud of old stagnant canals for several days until all the fleshy cellular matter is entirely decayed. A fibrous mass remains which is beaten with a mallet, washed in clear water and dried in the sun. The white silky fibre thus obtained is said to have deceived even experienced Burmese silk weavers.

6. Good rope is also made with the fibre of *Dendrocalamus strictus* (in Burmese, *Huagawak*), a bamboo (*Calamagrostis*) which grows wild throughout Upper Burma in thick clumps 10 to 50 feet high. The full-sized shoots only are used for this purpose. They appear at the beginning of the rains, in June. By November they have grown up to a

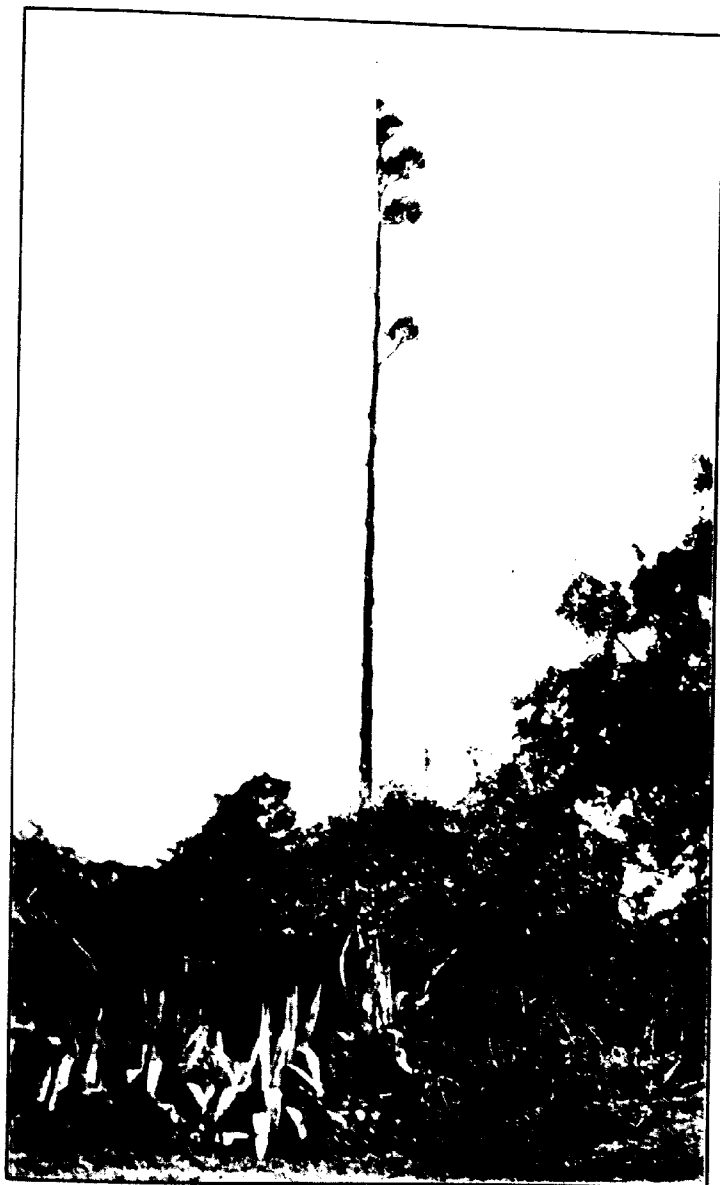
* This name is given to it locally by U. S. (or Kalywa) (Yamtha), formerly ex-Captain of the Burmese army, during the reigns of Kings Mindon and Thebaw.

height of 30 or 40 feet and are clad with fresh leaves. This is now the time, before these shoots have passed their sixth or seventh month, to collect the fibre and store it up to be made into rope as required. Passed this time, they harden and become useless. Long strips of the epidermis of the stem, the topmost smooth surface, are collected to weave mats—the well known glossy bamboo mats of Burma—and also long strips of the fibrous portion immediately under; the latter for rope making. After a couple of days soaking in water, they are twisted into rope. This rope is certainly inferior to that made with the fibre of *Hibiscus cannabinus*. The young shoots, 6 inches to a foot high (in Burmese, *Hagut*) which appear yearly at the beginning of the rains, are boiled or pickled. They make a dish much esteemed by the Burmese and during the season are sold in all village bazars.

7. *Corypha subacaulis* (in Burmese, *Pchin*) is a palmyra tree found throughout Burma and in Upper Burma especially, supplying a good fibre utilised for making ropes and cordages. This fibre is obtained from the tender new leaves found twisted and rolled up inside the huge conspicuous terminal bud growing at the topmost part of the stem of the tree. This terminal leafy bud is taken, the tender new leaves inside are unrolled and the median nerve of each one extracted, thus leaving each leaf divided into two strips. Rope is made with a number of these strips according to the thickness required. Generally two strips are used for the ordinary sized rope. But ropes of this fibre are rare and found only in tracts where this tree abounds, as the extraction of the terminal bud for its fibre kills the tree. (Plate XLII.)

8. The epidermis or external fibrous part of the petiole of the leaf in *Borassus flabellifer* (in Burmese, *Hatabia*), commonly known as the "toddy tree," is sometimes used for rope making. It is also with this epidermis, cut into thin equal strips of even width that the useful and well-known "pahs" rectangular shaped baskets with a lid or cover to fit and those beautiful multi-

PLATE XLIII



coloured mats, are generally skilfully woven. (Plate XLII.) The principal centres of manufacture are Pakokku and Myingyan in Upper Burma.

9. The pericarp or external envelope of the cocoanut fruit *Cocos nucifera* (in Burmese, *Oubia*) yields when dried a useful fibre—the coir (*onsau*), which requires soaking in water for a few days and beating with a mallet before it can be twisted into rope. Burmese agriculturists do not, as a rule, appreciate this rope, which they say is rough and would gall their bulls in no time. They prefer, with reason, the smooth rope made with the fibre of *Hibiscus cannabinus*. The coir ropes found in use locally are manufactured by jail labour in certain prisons in Burma or imported into the country from India.

The bark of certain hill forest trees supplies also a valuable material for the manufacture of ropes and cordages, which are exported chiefly by Chinese merchants to Rangoon, and thence to India or to the Straits; but this fibre, too costly and out of his reach, is seldom used by the Burman agriculturist in the plains.

THE TRANSPLANTING OF RICE IN CHHATTISGARH.

By D. CLOUSTON, M.A., B.Sc.,

Deputy Director of Agriculture, Central Provinces.

IN the year 1906 there were 4,259,826 acres of rice in the Central Provinces and 28,027 acres in Benar, or a total area of 4,287,853 acres for these Provinces. Of this area 754,342 acres were transplanted and 3,533,511 acres broadcasted. Of the transplanted area 365,047 acres were irrigated, and 389,295 acres unirrigated. The chief rice-growing districts are Chanda, Bhandara and Balaghat in the Nagpur Division, and Raipur, Bilaspur and Durg in Chhattisgarh. In the Nagpur Division 6·74 per cent. of the total area under rice is transplanted; in Chhattisgarh, with 2,830,974 acres, 37,878 acres or only 1·3 per cent. are transplanted and even this small area is confined to tracts bordering on the districts where transplanting is already in vogue. It is difficult to account satisfactorily for this important difference in agricultural practice between these two tracts, which are situated at no very great distance from each other and between which there is a good deal of inter-communication. Whilst the Wainganga valley districts consist of soil of crystalline formation, Chhattisgarh soil is mostly of laterite origin, but both seem equally suitable for transplanted rice. Want of knowledge or difference in the habits of the population can hardly account for the distinction. The most likely reason is that Chhattisgarh has hitherto had few facilities for irrigation, which is of more importance to transplanted than to broadcasted rice; but this difference is rapidly disappearing with the construction of irrigation works in Chhattisgarh. Chhattisgarh is the most backward agricultural tract in these Provinces, and the Chhattisgarhi is recognized as one of the laziest and least enterprising of cultivators. A large proportion of them are

chamars by caste. As a race they are strong and hardy, make good farm servants if properly managed, but are quarrelsome and are much given to agrarian disputes.

The soils of this division are mostly of laterite origin. They may be divided into four distinct classes. The partially decomposed laterite rock of the higher lands, which gives a red-dish gravelly soil, locally known as *blatta*, is the typical soil of large high-lying ridges covered with scrub and stunted grass, some of which bear at intervals a poor crop of the lesser millets (*Paspalum scrobiculatum* and *Panicum polypodioides*). The *blatta* grades gradually into *matasi*, a fine-grained yellow loam which is considered the ideal soil for paddy in this tract. *Matasi* like *blatta* is unsuitable for double-cropping on account of its tendency to harden after the rains into a brick-like mass, which it is almost impossible to reduce to a fine state of tilth by means of the cultural implements in use in this tract. Moreover, it does not retain moisture well. *Darsa*, or *darsasa* (meaning two kinds), is a mixture of *matasi* and *kanchar*; it is dark grey in colour, grows rice and rabi crops fairly well, and is therefore suitable for double-cropping. *Kanchar* is a dark loamy soil found at still lower levels; it contains less sand, and if pure, no nodules of limestone; it is very retentive of moisture. *Kanchar* is the best wheat-producing soil of the tract, but is not so good for rice, being too heavy. Dr. Leather's analysis of these soils is given below:

	Matasi.	Darsa S. 1.	Kanchar S. 1.
Insoluble silicates and sand	87.41	74.68	69.73
Ferric oxide	4.12	6.71	7.64
Alumina	4.78	11.43	13.83
Lime	0.78	0.85	1.05
Magnesia	0.36	0.81	0.75
Potash	0.43	0.86	0.79
Soda	0.13	0.26	0.25
Phosphoric acid	0.02	0.02	0.02
Sulphuric acid	Very little.		
Carbonic acid	0.13	0.99	0.88
Organic matter and combined water	2.40	1.35	5.86
	100.00	100.00	100.00
Total Nitrogen	0.038	0.01	0.06
Available phosphoric acid	0.01	0.01	0.01
Ditto do, potash	0.01	0.01	0.02
Equivalent to calcium carbonate	30	20	14

The Raipur Experimental Farm is fairly representative of this grading of soils, ranging from *blata* on the higher land outside the farm limits to the gently sloping fields of *mutasi*, *dorsa* and *kandhar* of the farm itself. The *mutasi* area is reserved solely for rice; the *dorsa* for rice followed by pulses, or wheat as the sole crop of the year, and the *kandhar* for wheat and sugarcane. The farm was established mainly with the view of solving problems relating to the cultivation of rice, the staple crop of the tract. One of the problems was to find the best method of sowing and after cultivation. The methods practised in these provinces are transplanting, *hutsi*, broadcasting and *lehi*. As practised in the Raipur Farm transplanting is carried out as follows: High-lying plots, where water does not collect, are selected as seed-beds, the whole rice area being divided up into 1/10th acre plots which are embanked with bunds 1½ feet high. The bunds were constructed five years ago, and have so far required very little repairs. The area of the plots selected for seed-beds is 1/10th that of the area to be transplanted. The seed-beds are ploughed by the country plough, soon after the removal of the previous year's crop, when the soil is moist after the winter showers. The plots are then twice harrowed in April or May, manured with cattle dung at the rate of about 5 tons to the acre in June, and again harrowed after the first shower of the rains. Seed is broadcasted at the rate of 200 lbs. per acre. The seed may be sown before the outbreak of the rains if the land is sufficiently free from weeds. The seedlings are ready in from three to four weeks, the time depending largely on the quantity and quality of the manure used. The plots to which the seedlings are to be transplanted are ploughed once in the dry weather. In the beginning of the rains when the soil is sufficiently saturated with moisture, the plots are again ploughed and cross-ploughed by the country plough, and finally puddled by means of the *datari*, i.e., a 6-foot beam fitted with harrow teeth. If the field is uneven, mud is dragged down from the higher to the lower ground by means of the same implement turned upside down, and then called a *kopar* or *mai*. The process of levelling with the *kopar* is shown below. (Plate XLIV.)



LEVELLING WITH THE *Koppe*.

Buffaloes are mostly used for rice cultivation, because they are stronger than bullocks and take kindly to wet work of this kind. In Chhattisgarh no nose strings are used for working cattle, but by a dexterous use of the goad, and cries of ar-r-r-r-, ha-ha-ha-ha, etc., which to the uninitiated are meaningless enough; the ploughman manipulates his animals with considerable skill within the small area circumscribed by the bunds of the rice plots. When the soil of the plot has all been reduced to a creamy consistency (of wet mud), the plot is considered ready for transplanting. The seedlings, which are, when ready for transplantation about one foot high, are uprooted, the worker resting on one knee in the muddy water while doing so. Each handful is tied into a small bundle and placed on a *khiri* or sledge, which is dragged to the plots in which the seedlings are to be transplanted. The *khiri* is so shaped as to run easily over the rice bunds.

The bundles are scattered equally over the plot to be transplanted, so as to be within easy reach of the labourers as they move backwards. The root and lower part of the stem of each seedling is pushed into the soft mud to a depth of one or two inches and at distances of six or nine inches apart. The plants take root in a week, at the end of which time blanks are filled up. By planting only one seedling to the hole the seed rate is about 20 lbs. per acre. At this rate the seed-bed will suffice to transplant ten times its own area. In some districts where transplanting is widely practised, the seedlings are planted out in bunches containing from two to five plants, and the seed rate per acre is about 50 lbs. One seedling per hole is the standard adopted both on the Experimental and Demonstration Farms. One woman can transplant 1-10th acre in one day of ten hours when seedlings are brought to her. In most parts of Bhandara and Balaghat the method of transplanting is different, the bunches of seedlings being simply thrown into the mud while the worker moves backward. The time spent in pushing the seedlings into the mud is thus saved, and the work is done much faster. This method, however, is open to objection. The seedlings not being fixed in the mud, it sometimes happens that

they are washed away by a heavy rain before they have time to take root. A long break in the rains just after transplanting may prove equally injurious, many of the young plants being killed by the drought before they have time to take firm root. The method now being introduced into Chhattisgarh is open to neither of these objections, and is practised by the very best rice-growers in the best rice districts. It requires more time, but reduces to a minimum the risk of injury to the young seedlings from too much or too little water. The work of transplanting as practised in the Raipur Farm is shown below (Plates XLV and XLVI). As a protection from the rains many of the workers wear a large *topi* made of leaves.

Of transplanting in Balaghat where rice cultivation is more skilfully carried out than anywhere else in the Central Provinces, Mr. C. E. Low, I.C.S., Deputy Commissioner, writes :— "Transplanting is the system usually pursued; it is said to give a larger outturn and grain of superior quality and flavour, and to be indispensable for the best kinds of rice. Broadcasting is usually practised in black soil where transplanting is more difficult than in light soil, and where early ripening varieties are sown to enable a second crop to be reaped. It is also adopted when a season of short rainfall is feared, or when the skill or resources of the tenants are not equal to transplantation; this is often the case with aboriginal cultivators in jungle tracts. For transplanting, the nursery is sown by the usual method adopted for all Kharif crops. Before sowing it is cultivated twice with a *magar* or narrow-bladed plough. A scarifier or *bukhar* is not used in light soil till a plough has twice been over the ground, so that the scarifier is not used for rice nurseries unless the land has been already ploughed up by the plough in the cold or hot weather. The manure consists of cow-dung, and before the application of this, straw, and, near the jungle, twigs and branches are often spread over the nursery and burned. (*Saj Terminalia tomentosa* is the favourite tree for this.) When the rain falls, this is ploughed into the ground, and the *datari* or harrow worked over the land to break up the clods. Seven or eight cartloads per half acre of nursery is considered a full manuring. Malguzas



A. J. L.

TRANSPLANTING AS PRACTISED IN THE RADUR FARM.

with a large home-farm have to start their manuring a month or so before the rains break. Manure is not always, or even usually, given to any part of the field besides the nursery. For transplanting the seed rate is about 85lbs. per acre. A transplanted field can be easily told even after reaping, as the plants tiller far more than if sown broadcast, and the ground is more free from weeds. The nursery, after ploughing, manuring and clod crushing, is completed, is cleaned of weeds by women with sickles. The seedlings in 20 or 25 days grow to a foot in height, when they are fit for transplanting. Meantime the remaining area is ploughed again and left for a week. The (*dataci*) harrow is used to break up clods, for which purpose it is turned upside down. The plough and the harrow are used twice each, by which time the surface consists of a smooth and creamy mud. Heavy rain just before transplantation spoils the consistency of the mud, and it has to be ploughed up again. The seedlings are uprooted from the nursery and stuck into the mud in bunches of about three or five; they lie flat for a day or two and then stand upright, except where there is very heavy rainfall, when they lie and rot; *giva kha gya* (the mud has eaten it) says the unfortunate cultivator. The crop later in the season looks miserably stunted and is scarcely in ears; while surrounding fields contain a full crop. The seedlings are carried in head loads in the case of small tenants, but on a *khirci* or sledge drawn by buffaloes, where cultivation is more extensive. If things go well, the transplanting for the district should be over in a month. The daily wages for transplantation are said to have risen from one anna before the 1896 famine to 1½ anna in 1905. The above methods, which in the best villages are conjoined with very careful seed selection, are not susceptible of much improvement. It is, however, likely that the seed rate could be considerably lowered, if the area outside the nursery were well manured and the seedlings were transplanted singly, instead of three to five at a time. The seed rate on the Government farms where this is done is less than half that described above."

Biasi is the method widely practised in Chhattisgarh. The land is ploughed once before sowing. The seed is broadcasted

at the rate of about 100 lbs. per acre. When the plants are about one foot high, the land is ploughed, which uproots many of the plants and covers some with mud. This process as commonly practised in Chhattisgarh is shown below (Plate XLVII).

This rough-and-ready process thins out the plants and strengthens the root-growth of those that are left. Five or six days later the plot is levelled by means of the *kopar*, which flattens all the surviving plants in the mud. In five or six days more weeding operations are commenced; two or three weedings at intervals of about a fortnight are generally necessary.

Broadcasting is the easiest and cheapest of all the methods in vogue. It is similar to *biasi*, but the seed is allowed to grow as it is sown; there is no thinning out of the plants. In its crudest form as practised in some of the Native States in Chhattisgarh, the land is ploughed at the beginning of the rains, the seed sown broadcast and covered by means of the *kopar*, and the crop is left untouched till it is ready for harvesting. As a broadcasted field ripens earlier than a transplanted one, broadcasting is generally practised in high-lying fields which are less retentive of moisture and where, for that reason, the earlier maturing rice only can be grown. This method is an alternative to transplanting in Bhandara and Balaghat.

By the *bhi* or *koorah* method the seed is steeped before sowing so as to hasten germination; otherwise, the method is the same as broadcasting. This method is practised in the Nagpur Division and parts of Chhattisgarh, and to the greatest extent in years in which the sowing has been delayed by heavy and continuous rain. In Jabulpore and Damoh under the name of *Machhawa*, it is the method commonly followed in the best rice soils.

On the Raipur farm these four methods are being tested in series A and B of the Experimental programme, A being irrigated and B unirrigated. Both series of plots are uniformly manured with cattle-dung at the rate of 20 lbs. of nitrogen per acre; the soil of the two series is *matasi*. The plots are each one-tenth of an acre in area. The paddy grown is *Parawa*, a medium variety. The results obtained are given in the statements following:



THE UNIVERSITY OF CHICAGO

Plant	UNDER AVERAGE COTTON YIELD PER ACRE IN THE												Average value of cotton		Total cultivation, including A/c.		Average profit, loss due to each in dollar	
	1964-65			1965-66			1966-67			1967-68								
	Cotton	Soybean	A/c.	Cotton	Soybean	A/c.	Cotton	Soybean	A/c.	Cotton	Soybean	A/c.	Rs.	P.	Rs.	P.		
I. Transplanted	1,940	1,440	40	1,620	1,840	41	1,680	1,130	46	Rs.			14	6	14	6		
II. Broadcast	1,620	1,000	26	340	1,900	39	710	780	30	Rs.			10	6	19	6		
III. Broadcast	720	640	19	740	1,240	29	750	800	32	Rs.			8	11	18	10		
IV. Local	920	1,040	24	430	780	19	970	980	11	Rs.			10	17	6	9		

Figs.	TREATMENTS. GRAIN IN THE CORN IS 100.											
	1904-05.			1905-06.			1906-07.			1907-08.		
	Grain.	Straw.	Value.	Grain.	Straw.	Value.	Grain.	Straw.	Value.	Grain.	Straw.	Value.
I. Transplanted ..	2,060	1,540	47	1,910	1,220	54	1,940	1,430	47	1,520	1,180	46
II. Broadcast ..	1,570	1,070	40	1,610	1,160	49	1,240	1,130	30	1,160	1,120	48
III. Broadcast ..	920	700	24	1,190	970	36	1,220	1,410	31	1,120	1,180	48
V. Lohi ..	770	1,270	22	1,120	860	31	730	680	17	980	970	41

Transplanting without irrigation has increased the value of the yield by Rs. 17-12 per acre. Irrigation alone has raised the value of the yield by Rs. 10-6, even with *biasi*. When transplanting and irrigation are carried out together, the monetary value of the increase when compared with the Chhattisgarh method of *biasi* sowing without irrigation is Rs. 24-6 per acre.

The conclusions in brief to be drawn from these results as far as they apply to this division are : (1) that transplanting is a most profitable method even without irrigation where medium paddy is grown; (2) if the Chhattisgarhi will but irrigate his *biasi* paddy, he can increase the value of his crop by over Rs. 10-6 per acre; and (3) by adopting transplanting with irrigation, he can increase his profits by Rs. 24-6 per acre.

The water-supply on the Raipur station has so far been very inadequate, and for that reason late-ripening paddy has not yet been tried in these series. With a late heavy yielding paddy and an adequate water-supply, the results would have been still more favourable. This is at least indicated by the outturns obtained on the demonstration farms last year, where *Gurumati*, a late paddy grown in this division, was sown.

The results were as shown below :

Name of Farm	Yield of Department in lbs. per acre	Yield of Cultivators in lbs. per acre	Increase in lbs. per acre	Value of Increase in Rs. & P.			
				per standard			
				1 year's normal rainfall	1 year's drought	1 year's normal rainfall	1 year's drought
Jageshwar Farm	3,540	2,450	1,090	Rs. 35	7	19	11
Jawarbandha Farm	1,900	1,400	1,500	25	15	36	7
Kolar Farm	2,880	1,272	1,608	38	5	34	9

The transplanted plots of the department and the *biasi* plots of the cultivators were manured alike and irrigated alike, so that the difference in the outturns is due to the superiority of this new method of sowing introduced. The result appeared all the more striking to the village cultivators, because the department

PLUGGING THE LAND



only took over these demonstration plots about a fortnight before the rains, and no manure was applied save that which had been added by the ryot himself. He followed the example set to him by the demonstration farms and irrigated his rice this year for the first time. Even the primitive mind of the *chamar* could not fail to see that under these circumstances the increase in the outturn must have been due to the one varying factor, *viz.*, the method of sowing. As a cultivator, he could not help seeing that on the demonstration plot the *Sircar* (Government) produced a better crop than his own by means that were at his disposal.

In his inspection note on these farms Mr. F. G. Sly, I.C.S., Director of Agriculture, writes : " It has been fairly demonstrated that the outturn of rice can be very largely increased, indeed, almost doubled, by adopting transplanting instead of *biasi*. All the villagers frankly agreed to this conclusion, and have been evidently much impressed with this demonstration. In discussing the matter with them, I found that most had decided to transplant some of their land next year. Two objections were put forward to a large extension of the practice. The first is that transplanting is more insistent in its demand for water at a particular time ; but they agreed that this is no difficulty under good irrigation tanks. The second is that it demands a large supply of labour at the particular time of transplanting, although the total expense is smaller owing to saving of seed and to the avoidance of all weeding after transplanting. This objection has some force, but it is hardly likely to stand in the way of the adoption of such a profitable practice. A third objection is that the system is difficult in parts where the holdings are very much scattered (the survival of the *lakha-bhatta* system) ; but this should not militate much against a large increase in the transplanted area. So far as our experience goes both on the Government farm and on the demonstration plots, I cannot point to any strong reason why transplanting should not succeed and extend in Chhattisgarh ; although if this is the case, it is extraordinary why it should not have been introduced earlier, seeing that it is practised in the neighbouring districts of Balaghat

and Bhandara and to a very limited extent in Chhattisgarh itself." The introduction of transplanting in a paddy tract is an enormous boon in the increase in outturn due to this method of sowing. It is a means, too, of inducing the cultivator to irrigate his crop, as the department recommends that for the present transplanting should be restricted to irrigated areas where late paddies can be grown. The importance of irrigation alone to this tract can scarcely be estimated, for the Chhattisgarhi cultivator is more dependent on water than any other in these Provinces. In a year like that just past, irrigation for him meant a bumper crop, while the want of it meant a very poor yield, much suffering and the necessity of Government relief to tide him over a year of indigence. Despite these facts, the Irrigation Department has experienced very great difficulty in inducing the cultivators of this division to utilize the water of Government tanks, for that the Chhattisgarhi does not yet fully appreciate the value of water as a factor in increasing the yield of his crops, is evident from the fact that of 2,839,074 acres of rice in this division, only 23,528 acres were irrigated during 1907-08. It was clearly the duty of the Agricultural Department to take up this line of work in earnest, and these demonstration farms were therefore started *last year* (1907), mainly with the view of getting this backward class of cultivators to incorporate into the general farm practice of their villages, the results of the work done at the Raipur station, by transplanting and irrigating their staple crop.

Demonstration work has so far been beset with many difficulties, and has in the past been the least successful of all the lines of work undertaken by the Agricultural Department. The success of the work last year was due to the following reasons :

(1) that it was undertaken and carried through with a definite aim; (2) that the department only attempted to demonstrate methods which had been clearly proved by experiment at the Raipur experimental station to be practicable and profitable; (3) that the work was carefully supervised; and (4) that the cultivators were made to feel that the work was done solely in their interest.

Other steps taken to popularise this method may be described. Cultivators are encouraged to inspect the Raipur Experimental farm and see for themselves the results obtained from transplanting there : this farm was visited last year by 4,203 visitors. All the meetings of the Raipur District Agricultural Association are held on the farm, and the members are shown plots of transplanted and *baasi* rice growing side by side, which is an object lesson that appeals to all. A statement of the results obtained from transplanted and *baasi* plots, respectively, on the experimental and demonstration farms, is prepared in the vernacular on large cardboard sheets, and the results explained at meetings of the Agricultural Association and at fairs. Short articles on the same have appeared in the vernacular editions of the *Agricultural Gazette*, published by this department : and finally, transplanting was demonstrated last year on the demonstration farms.

As a result of these methods of bringing the advantages of transplanting to the notice of cultivators, it was felt this year that the time had come to induce cultivators to attempt this important improvement on a large scale in their villages.

Last year the object aimed at was to make the demonstration farms a thorough success and to gain the good-will and confidence of the villagers. With this end in view the department supplied both bullocks and seed, and care was taken to see that the agricultural Assistants did not worry the visitors by requests for supplies. It was found necessary, however, to promise the cultivators concerned, that if the crop of the demonstration farms proved a bumper one, they would get all the produce, while if it was only a medium crop, the department would recoup itself by demanding one half of the same. This condition proved most effective in preventing the owners of the crops from allowing their cattle to graze at night in the rice fields, which is a common practice in Chhattisgarh, and which threatened at first to interfere very seriously with our work owing to the injury done to the nursery beds.

The agricultural assistant in charge allowed such cultivators as expressed their willingness to transplant small areas to take

spare seedlings from the nursery plots of the demonstration farms. Cultivators from the neighbouring villages were encouraged to come and inspect the plots transplanted by the Department, and the names of those who promised to transplant this year, and the area to be transplanted by each were recorded. Before last year's crop was harvested, a rough estimate had been formed of the area to be transplanted this year, and nursery beds for the same were prepared during the dry weather. The villages were grouped into what we call demonstration centres, there being four or five villages in each. Each centre was under the charge of an agricultural Assistant, and a ploughman experienced in transplanting was placed under his orders in each village. In villages where the malguzar complained of shortage of working cattle, a pair of buffaloes was also sent to him. It was decided to supply the seed free of cost whenever necessary, for two reasons:—(1) because where the cultivators have not been accustomed to irrigate their rice, they grow early or medium varieties, which do not yield so well as the late variety, namely, Gurnatia, which is largely grown on the Raipur farm, and which is recognized as the best heavy-yielding paddy in Chhattisgarh; and (2) free seed was to many an inducement to transplant, more especially to those who had fared badly owing to last year's scarcity. The villagers as a whole share equally in the work of ploughing and sowing the nursery plots, and each transplants his own fields with the seedlings taken from the nursery plots. The nursery plots are thus common property. This co-operation is carried still further when the seedlings are ready for transplanting, and it is no uncommon sight to see almost all the village ploughs at work in one field. In the case of the work being unnecessarily delayed the malguzar is always appealed to by the agricultural Assistant in charge. In villages where the malguzar and tenants were well-to-do, they supplied their own seed. Of the area to be transplanted, the department has supplied seed for 550 acres; while the cultivators are using their own seed for nearly 1,000 acres.

The one great difficulty experienced in carrying through this rather ambitious scheme of work has been that of supply:

competent agricultural Assistants to put in charge. Owing to the paucity of Assistants, it was found impossible to comply this year with all the demands made for assistance in introducing this new method. In the absence of trained men, the department has adopted a plan which promises to be successful in practice. Ploughmen experienced in transplanting have been obtained from districts that are more advanced in rice cultivation. These have been sent out together with a few Chamar ploughmen from the Raipur Farm, some being attached to demonstration centres where they work under the agricultural Assistant in charge, while others are employed in villages where they work under the direction of the malguzar or other respectable cultivator at whose request they have been sent. With the assistance of such men the malguzars of certain villages are transplanting from 20 to 40 acres this year, and some of them are retaining the services of the ploughmen at their own cost. With very few exceptions these malguzars are members of the District Agricultural Associations. In many cases these ploughmen have proved more reliable than some of the agricultural Assistants who have been put in charge of this work. They are at least practical agriculturists and belong to the best farming centres, which is not true of many of our Assistants. As ploughmen they have been accustomed to hard work under the rather uncongenial conditions which characterise village life in a paddy tract, and readily adapt themselves to similar conditions when transferred to another district. Not so the Brahmin who, accustomed to the comforts of town life and the society of his own caste-fellows, finds life in a humble chamar village almost unbearable, and leaves his work to look after itself on the pretext of illness.

As ploughmen for this kind of work are not available in Chhattisgarh itself, arrangements have been made to train boys in transplanting on the Raipur Farm. Twelve orphan boys varying in age from 13 to 19, have already completed their training there this year, and will be employed in future, either by the Missions to which they belong or by the Department of

Agriculture, in introducing this method among cultivators. Next year a new batch will be trained, and members of the Agricultural Associations and others interested in the work will also be asked to send men to undergo this training.

That this piece of demonstration work has produced results beyond all expectation, that a great amount of work has been accomplished this year with a very small trained staff, and that even the chamar cultivators have learnt a most useful lesson from it, is amply proved by the fact that this year with five Assistants and twenty-four ploughmen experienced in transplanting, the Department is transplanting about 1,300 acres scattered over 39 villages. In addition to this the members of the Agricultural Associations, to whom assistance could not be given this year, have agreed to transplant in all about 250 acres.

The success of this piece of work is due in no small measure to the very effective supervision exercised over it by the Superintendent of the Raipur farm; for in these Provinces the policy of the Agricultural Department is to put the Superintendent of the experimental station of each division in charge of the demonstration work of the same. This answers admirably, where the Superintendent is a sound practical man. The experimental work and demonstration work form parts of one great scheme; the one is incomplete without the other. If separate Assistants were made responsible for the different parts of that scheme, there would be less efficiency and much less work done per man. With one Superintendent for both, cultivators are made to feel that the demonstration farms are but off-shoots of the experimental farm, the one difference being that the former demonstrates only, while the latter experiments and demonstrates. The Superintendent inspects each centre once a month. The Assistants in charge of the different centres forward weekly diaries to the Deputy Director through the Superintendent. The Deputy Director inspects the different centres as often as possible.

This year's results show that the opinion held by many to the effect that the Chhattisgarhi is too lazy and unenterprising to adopt transplantation, that his bullocks are too weak for it and

his soils unsuitable, is at least open to doubt. Our experience of the *chamar* ploughmen at the Raipur farm is that they are very good workers when properly directed, though lacking in initiative. Judging from the large number of *chamar* cultivators who have this year come from neighbouring villages for seedlings, which they have uprooted for themselves and carried away in head loads for four or five miles, I am convinced that the term "lazy" is not applicable to them all. In any case it is the duty of the Agricultural Department not only to demonstrate improvements, but also to encourage, direct and otherwise assist the less enterprising cultivators to adopt them. That his soil is suitable for transplanting, there is no shadow of doubt.

That the weakness of the small Chhattisgarhi bullock will stand in the way of extensive cultivation of any kind is evident : still there are already in every village a few fairly good buffaloes and bullocks of sufficient strength to do all the extra work required for transplanting on a moderate scale even under existing conditions. Next year the Department intends to make the conditions still more favourable for transplanting by encouraging the cultivators to make a lighter *datari* specially for this work and by letting out buffaloes on hire to cultivators at the rate of one pair for each area of 50 acres to be transplanted.

In his inspection note on the work which is being carried out this year, Mr. B. P. Standen, I.C.S., C.I.E., Director of Agriculture, writes as follows :

There can be no doubt that transplanation has come to stay in Chhattisgarh. Nearly the whole of the 38,000 acres now transplanted in this division lies in the zamindaris situated in the hills and jungles to the south, east and west. I am told that a great deal of this so-called transplanation consists rather of thinning by hand than of transplantation proper. All cultivators who have witnessed the demonstrations have been deeply impressed by the great saving of seed and the large increase in the outturn. The difficulties to be overcome before the area transplanted will expand largely, are those mentioned in Mr. Sly's inspection note, together with the scarcity of strong plough

cattle and a rumour started by ill-disposed persons, that all transplanted land will be assessed to rent and revenue at a specially high rate. The Settlement Commissioner has promised to take steps to contradict this rumour, and, as the revenue of the greater part of Chhattisgarh is about to be fixed for 20 years, it is not likely to affect transplantation after the current year.

At present the demonstration plots are confined to irrigable land, and it is desirable not to urge transplantation at present on unirrigable land, although it is safely practised on large areas in the Wainganga valley, where the rainfall is somewhat higher (*vide* Mr. Clouston's, para 1). In that part of the country the rice bunds are generally higher and the fields hold more water than in Chhattisgarh, so that risk of damage by drought is less. When once well established in the irrigable lands of Chhattisgarh, the practice will be readily extended to dry areas. There is no reason to suppose that the labour difficulty offers any serious obstacle. Labour is more plentiful than in the Wainganga valley, but the transplanters naturally work very slowly : with practice they will complete their tasks in one-third or one-quarter of the time, and cultivators will find that they have ample leisure for weeding the *biasi* crop, after transplantation is completed. In connection with this part of the subject, it may be mentioned that although the cost of weeding a *biasi* crop properly is not less than that of transplanting rice on a similar area, the Chhattisgarhi very often weeds his crop very perfunctorily, securing no doubt a much smaller crop, but at the same time avoiding expenditure which he perhaps cannot afford without borrowing at a high rate of interest. To such a man the unavoidable expenditure on labour in transplanting is a serious consideration.

The want of a sufficient number of strong cattle seems to be the most important obstacle at present. The Chhattisgarhi bullock is the smallest and weakest in the Provinces, rarely more than 36" high behind the hump and always in very bad condition in July, when the heavy work of transplantation has to be got through. Buffaloes are used for all heavy work and with the *datari* used now, are indispensable to prepare the fields for trans-

plantation. It may be possible for the little bullocks to pull the small *dhotoris* which will be tried next year : but for really thorough cultivation, I think, buffaloes will be required. There is now one pair of buffaloes for every 28 acres of rice land in Raipur District, including the zamindaris : but the proportion of buffaloes to rice is much smaller than this in the open parts of the Khalsa. It is found impossible to breed useful buffaloes in the open country, owing to the absence of good grazing areas and the great heat of the shadeless plains : consequently all the buffaloes in the open country are imported. By far the greater number come from Rewah and Saugor, and are bought at from Rs. 60 to Rs. 80 a pair. A few are brought from the zamindaris of Kauria and Bindra Nawagarh. In these remote places there is little demand for *ghā*, and the calves get most of the milk, so that they are fine strong animals and sell for double the price fetched by those from the north. They are consequently less used. Transplantation, while increasing the demand for buffaloes, will provide the cultivator with the means for purchasing them, and we may hope that in a short time the effective demand may so far increase as to make it worth the while of the inhabitants of the northern Feudatories to follow the example of their neighbours in Rewah, and send cattle to the 'Khodoti.' Meantime we must do what we can by hiring out buffaloes to needy cultivators, as suggested by the Deputy Director of Agriculture, by *tacavi* loans and possibly by co-operative credit to make smooth the rough path of progress under the feet of the conservative Chhattisgarhi till he begins to cry 'Excellior' without prompting.

This note may fittingly end with the statement that if a normal crop is reaped this year, the additional profits put into the pockets of cultivators by the labours of Mr. Clouston, Mr. Tindilall Powar and their assistants, will considerably exceed the whole of the annual expenditure on their salaries and the cost of the experimental farm at Labandila."

Transplanting should in future extend very rapidly in Chhattisgarh, if the Agricultural Department continues to work on the present lines. Of the enormous gain which its introduction will

mean to the farming community of this division, it is impossible to form anything like an adequate estimate. It should be possible within the next twenty years to raise the standard of cultivation to that already attained in Balaghat. For Chhattisgarh that would mean 1,926,450 acres of transplanted rice or an increase of 1,897,892 acres, which would increase the profits of the farming community of this division by nearly four crores of rupees annually.

PLATE XLVIII.



RICE CULTIVATION IN LOWER BURMA.

By A. McKERRAL, M.A., B.Sc.,

Deputy Director of Agriculture, Burma.

THE cultivation of rice in Burma has for long been the most important item in the agriculture of that country. Admirably adapted both as regards soil and climate for the production of this cereal, Burma is to day the main rice-growing province of the East. For the year ending 1906-7 the exports of cargo rice from Rangoon amounted to about 2½ million tons, most of it being shipped to the Straits, Japan, India, and Europe.

The area under paddy is, moreover, rapidly increasing. Last year showed a total increase of some 9,000 acres, while the increase for the last five years, due to the boom in the rice trade and the competition among the various rice firms of the country, may be seen from the following table :

For the year ending	Area under paddy in Burma
1900	8,559,145
1901	8,557,154
1902	8,595,351
1903	9,306,531
1904	9,265,464
1905	9,281,407
1906	9,294,769

This shows an increase of nearly 9 per cent. in these six years. It may be of interest to readers of the *Journal* to know something of the conditions of soil, climate and cultivation under which this important crop is produced.

Agriculturally, Burma may be divided into 4 zones : (a) the wet zone of Upper Burma, (b) the dry or arid zone of Upper Burma, (c) a middle or central zone and (d) the Delta zone,

embracing the delta of the Irrawaddy River and also Amherst and Tavoy in the South.

In the dry zone and on parts of the central zone, paddy is either grown under irrigation or dry land varieties are sown, but in the Delta zone the natural rainfall is usually more than sufficient to produce good crops, and on this area the bulk of the rice crop of Burma is grown. It is with cultivation under the latter conditions that the present article is concerned.

The normal rainfall of the principal delta districts from 1st April to 30th November—the period during which the paddy crop is grown—is given in the following table.

District	Normal Rainfall in inches from 1st April to 30th November.
Akyah	197.90
Bassein	133.25
Wakema	95.58
Pyapon	91.35
Rangoon	97.03
Pegu	126.74
Nyaunglebin	127.28
Thaon	219.46
Amherst	204.92
Tavoy	211.91

It will be seen from the table that the demand of the semi-aquatic rice plant for moisture is amply met in all these districts.

The soils on which the cultivation takes place consists of what is geologically termed *recent alluvium*. Agriculturally they may be described as in general consisting of a stiff clay overlying a still stiffer clay subsoil. On drying in the hot weather they become generally very light in colour, crack readily, and assume a degree of hardness which practically precludes cultivation at that season of the year.

A remarkable fact in connection with the soils is the manner in which they appear to retain their fertility under successive crops of paddy and with little or no manure. Several sources of natural manurial supply, however, are evident; a considerable amount of grain is left annually on the soil due to "shaking" in the over-ripe ears; the stubble is left very long at reaping and is



BURMESE PLOUGH (HTE).

A. J. L.

either burned or ploughed in the next year: near the villages a considerable amount of manurial matter must be washed down from the houses and cattle sheds during the first showers of the monsoon, and there is in addition the possibility of small amounts of nitrogen entering by way of Leguminous weeds, or by washing from the atmosphere.

These sources, however, can hardly be expected to make up for the loss sustained by a yearly yield of 30 or 40 bushels or more of grain per acre, and the probability is that those paddy lands of the Irrawaddy Delta which are cropped year after year without manure of any kind and without the practice of rotations, are slowly, but gradually, undergoing exhaustion. This fact seems to be realized by the Burman cultivator, who prefers new land situated low enough to secure an efficient water supply or land adjacent to villages which has been manured naturally in the manner above described. On the whole there is good reason to suppose that future investigation on the Experimental Farms will prove the delta paddy soils to be quite as responsive to manurial treatment as soils in general are.

All fields are banded, the bands being as a general rule about a foot high and a yard in breadth. The proper care of the bands is one of the most important concerns to the paddy cultivator. As soon as the soil has been softened by the first showers of the monsoon, breaches in the bands are carefully repaired prior to cultivation, and at the same time their height is increased by adding soil from the adjacent fields. The disposition of a field often makes a wonderful difference in the time at which cultivation becomes possible. It is quite a common sight to see adjacent fields on one of which cultivation is in progress, while on the other nothing can be done owing to want of water due to the high level.

The area of the fields varies from very small plots of one-eighth or one-tenth of an acre or less up to fields of an acre or an acre and a half.

As a general rule, if the land is low and level, the area is larger.

Cultivation begins as soon as the first showers of the monsoon have softened the land sufficiently to admit of ploughing. This is usually about the last week of May or the first week of June.

In all good soils, when the rainfall is sufficient, early and abundant, transplanting is resorted to. But when the rain comes too late, or the cultivator is at a loss to obtain labour in time, the seed is simply broadcasted by hand. The Burman is perfectly aware of the superior merits of the transplanting system, which is practically universal in the Delta areas.

The first field cultivated is the nursery. This is most carefully chosen and is generally the best field possessed by the cultivator, being one in which an early and abundant supply of water is got. After the bunds have been carefully repaired, the nursery, if it contains sufficient water to render the soil soft, is ploughed with the *btin* (Plate XLVIII). This is the Burmese harrow, and consists of a log of wood in which are inserted a varying number of wooden teeth. For paddy cultivation on the delta the one with six teeth is generally found most convenient. With this implement the soil is gone over six or eight times until it is of the consistency of fine soft mud, and on this mud the paddy seed is broadcasted at the rate of about one to one and a half baskets or more per acre.

The practice of sprouting seed before sowing is occasionally resorted to. The seed is soaked for a day and a night in water and is then placed outside the cultivator's house on a bamboo platform and covered with plantain leaves. Under these conditions the seed germinates, and growth in the field is expedited. But the practice is open to objection owing to the damage done to the young shoots in handling, and is only resorted to when the nursery is in a more or less unsatisfactory state owing to want of water.

Should the soil be originally too stiff to use the *btin*, it gets a ploughing with the *Hô* or Burmese plough (Plate XLIX). This implement resembles more or less the usual type of primitive Eastern plough consisting essentially of a wooden sole with iron



A. J. L.

SETTIN (USED FOR CUTTING GRASS ON PADDY LAND).

share, a handle, and a pole for attachment to the yoke of the bullocks. Its use is more common on the dry lands of Upper Burma than in the paddy cultivation of the Delta, where it is only used when absolutely necessary.

Both these implements—the *tôn* and the *Htê*—cultivate to a depth of only some 2 inches below the surface. It is often argued that the delta soils of Burma are so shallow that deep-working implements produce harmful effects, but the shallowness must be due in great measure to the continual shallow cultivation with these implements, resulting in the formation of a kind of "pan" at a depth of 4 inches or so below the surface. It should be remarked that manure, when it is used, is applied to the nursery only. It consists of either cow-dung or paddy husk, and these are applied in small quantities about a month before cultivation commences and subsequently ploughed in. The usual rate of application is about five or six cartloads per acre. The quantity of cattle manure available is limited, as Burmans do not keep milk cattle, but only as a rule a pair or two pairs of working bullocks or buffaloes, the manure produced by which is, as a general rule, badly collected and preserved.

While the young plants are growing in the nursery, the cultivator turns his attention to his other fields. By this time the monsoon has fairly set in, and this produces as a consequence a rank growth of grass on the fields which he has still to cultivate. To get down the grass Burmese cultivators use an implement called the *setthin* (Plate 12). It consists of a round pole of hard tough wood about 2½ inches in diameter. To this are affixed transversely a series of very sharp steel blades. The ends of the pole work in "bushes" in two wooden side pieces, and the blades, when the machine is dragged by the bullocks, revolve and cut down the grass.

The machine is in reality a simple form of lawn mower and is a very popular implement among paddy cultivators. Its use, we believe, dates back only some 25 years. The price is about Rs. 25.

When the grass has been got rid of by the *setthin*, the *tôn* is used to get the soil into suitable condition for the transplants.

These are generally taken out of the nursery about a month after sowing, and are then about a foot or a foot and a half high. If the nursery soil is not good, however, it may be necessary to give them 40 days or so before they can be transplanted.

Transplanting, which is generally done by women, is performed as follows :—The plants in the nursery are pulled up and put in bundles of about 1,000 or more. These are carried to the fields and thrust into the ground in clumps of three or four together and at distances of about 6 or 8 inches apart. Transplanting is in some cases done by means of a bamboo stick which is used to thrust the transplants into the ground. The practice greatly expedites the work and at the same time relieves it of its drudgery, as continual stooping is rendered unnecessary. Recent experiments in Bengal seem to prove that one plant per hole gives as good results as four or five, and it will be interesting to discover whether the same holds under Burmese conditions. As a general rule, a paddy nursery in Lower Burma is reckoned to plant out from eight to ten times its own area. If one plant per hole gives as good results as three or four, it is evident that a considerable saving of seed might be effected.

In Upper Burma the work of transplanting is performed by women, who sometimes plant in time to the music of a Burmese band which is stationed on the edge of the field. The efficacy of this method is somewhat doubtful, as the care taken in transplanting and the speed at which it is accomplished are not always commensurate. The practice is an interesting survival of past customs and is quite commendable from the point of view of the workers. Transplanting paddy is laborious and dirty work, and the need of such a stimulus is perhaps excusable. The Lower Burman, however, has so far discarded the customs of his forefathers as to consider this aid to the work unnecessary.

From the time that the paddy is transplanted up to about a fortnight or three weeks before it is reaped, the fields are submerged under several inches of water. This water, however, must be got off just when the grain is ripening, otherwise the proper degree of hardness is not obtained. It is sometimes difficult



SHOWING (A) MORTAR AND PESTLE FOR HUSKING PADDY (WORKED BY HAND).
 (B) " " " " (WORKED BY TREADLE).

to get rid of the surplus water in time, but as a general rule it can be run off into the marginal ditches, or it dries up by evaporation in time to leave the field perfectly dry at harvest time.

Harvesting takes place from the middle of November onwards, but December and January are the important harvest months. One very early glutinous variety known as *Kaukyin* is cut about the end of September or beginning of October.

Before harvesting and when the paddy is fully ready for reaping, men go through the fields and "fell" the standing crop flat to the ground with large bamboo poles. As all cutting is done by means of a sickle, this falling in one direction considerably facilitates the work of reaping. The cut crop is bound into sheaves which are left to dry on the field for a few days before being taken to the threshing floor. The sheaves are sometimes placed on the bunds, a precaution against a late shower of rain. When rain does fall, as it did last year, in December, considerable damage may be done to the cut crop. The bunds retain practically all that falls, and the grain, softened by the moisture and subsequently subjected to the sun of Lower Burma, sprouts and is rendered useless.

"Stooking" is occasionally resorted to, but is not a general practice.

The grain is threshed and winnowed in the usual way by bullocks and by hand. Threshing machines and winnowers are unknown, but it is possible that if their efficiency were once realized, many of the larger cultivators would adopt them.

A drawback to the use of these, as also to the manuring of the land, is that cultivators live generally in villages often at considerable distances from their holdings. Such a thing as actual living on the holding, is rare, and transport is often a serious item in the bill of costs.

With regard to the varieties of paddy used, nothing definite is as yet known. The Burmese claim to have about 120 varieties of Lower Burma paddies, but it is doubtful if these are all different types. Varieties are classified with respect to time taken in coming to maturity. Early ripening varieties are known as

Kaukyin paddies, medium ripening varieties as *Kauklut*, and the latest as *Kaukyi* paddies. There is about ten days' difference or a fortnight's difference between each of the three kinds, so that *Kaukyin* varieties mature about a month sooner than *Kaukyi*. The greatest demand at present by the large rice mills is for the varieties known as *Nyasein* and *Nya Chauk*, while other varieties find favour among the small native mills or for eating purposes by the Burmans themselves. (Plates LI & LII.)

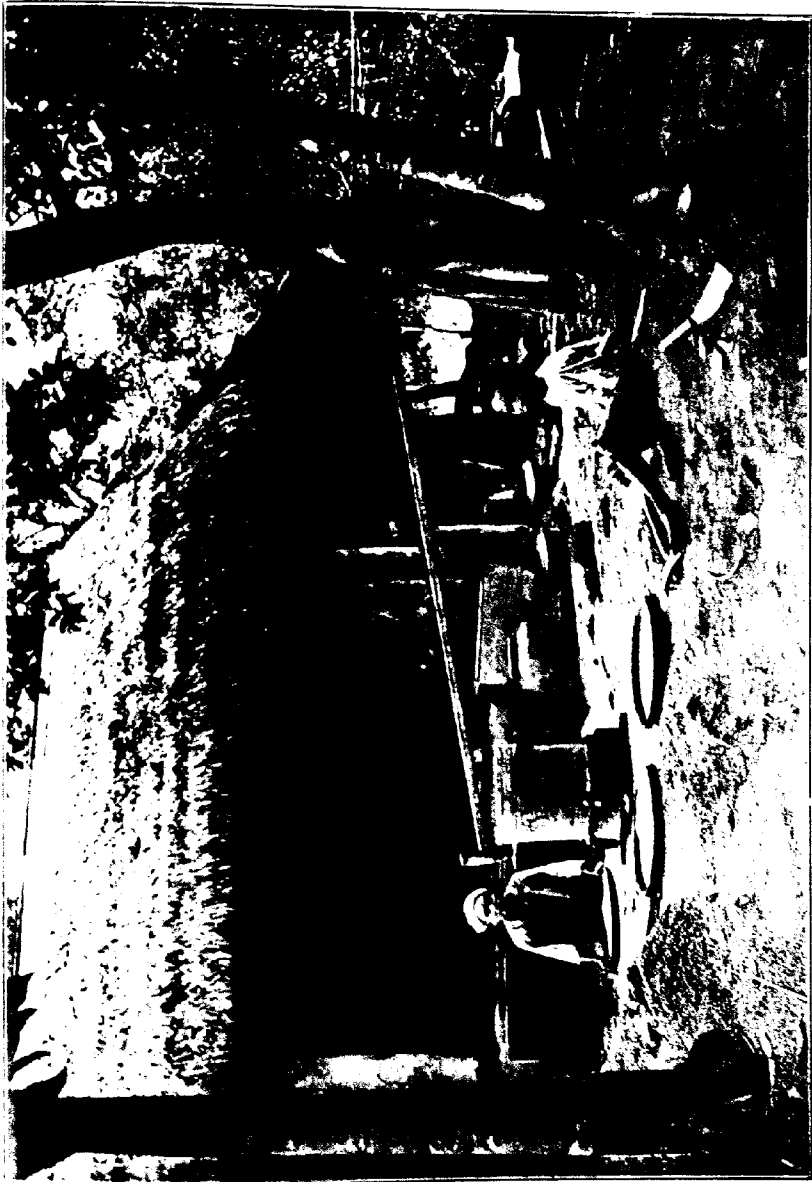
Sales of grain take place at the threshing floors, where the brokers buy from the cultivators and re-sell to the large rice mills, or occasionally the large rice mills may send their own brokers. The price during recent years has been high. Last year as much as Rs. 165 for 100 baskets (9 gallons capacity) having been given in Rangoon. The cultivator of course gets much less, as the broker's commission has to come out of this, and probably from Rs. 80 to Rs. 100 per 100 baskets is a fair average price for a cultivator to get. In selling paddy in the districts there is no weight standard, but in Rangoon a standard of 46 pounds to the 9 gallons basket has been adopted, so that sales there are virtually by weight.

The cost of cultivation per acre is somewhat difficult to ascertain as the cultivator has not as a general rule, a good idea of what an acre is, and no reliable experimental records are available. The following profit and loss sheet, however, will convey an approximate idea of profit per acre :-

Cost of ploughing, sowing and seed	Rs. 4.80
" transplanting	" 5.00
" reaping	" 5.80
" rent	" 6.00
Total expenses Rs. 21.60	

If the land yields 40 baskets, and this is sold at Rs. 4 per basket, the net profit per acre is Rs. 19.

As the yield, however, varies very much, as also the price from year to year, the net profit is somewhat uncertain, but on a wide average Rs. 20 to 25 may be taken as fairly representative.



A. J. L.

BURMESE PADDY HUSKING MILL.

Holdings vary much in size and may either be the property of the cultivator or rented by him. A common sized holding runs from 15 up to 30 acres, but in some parts of the delta we get holdings of two and three hundred acres in extent.

Well-to-do holders do not themselves work on the land and invariably employ hired labour. Natives of India and emigrants from Upper Burma supply what is required in that respect. Migration from Upper to Lower Burma is greatest at the reaping times, the certainty of the paddy crop in the delta thus forming a kind of guarantee against want to Upper Burmans whose crops are very often at the mercy of an insufficient rainfall.

A striking fact in the economy of Lower Burma is the amount of indebtedness among paddy cultivators. Although the rice crop rarely fails, except under conditions of flooding or late and careless cultivation, still much of the paddy land is mortgaged to the money lenders. A believer in the maxim of *carpe diem*, the Lower Burman freely spends his paddy profits in *pwees* (musical festivals), in building pagodas, and in various religious offerings. As a result the *chetty* is abroad in the land.

To sum up, it may be said that on the whole cultivation in Lower Burma is careful and good, according to the lights of the people. Its weak points are want of care in conserving and applying manure, also the absence of good methods of cleaning, grading, and selecting seed with a view to improve the type. The latter defect is, however, common to all Eastern agriculture which does not, as is the case in Europe, possess the advantage of having professional seed experts who make it their business to put on the market only the best samples.

THE CULTIVATION OF TAPIOCA IN TRAVANCORE.

By T. PONNAMBALAM PILLAY,

Ecceis Commissioner of Travancore.

THE manihot, Cassava, or tapioca plant (*Manihot utilisima*), belongs to the *Euphorbia* tribe, and is closely related to the ceara rubber (*Manihot glaziovii*) so well known to every planter. It is now very commonly grown in Travancore, being the source of the tapioca meal, which constitutes an important article of food of the people of that State.

It is not indigenous to India, but appears to have been introduced from the tropical parts of South America. In Travancore, its introduction was due to H. H. the late Maharaja, who took great interest in the welfare of his subjects. By the introduction of this food plant, the large population of Travancore has been to a large extent placed beyond the reach of the famine conditions which prevail in other parts of India.

There are about 15 varieties of the plant cultivated in Travancore. There is, however, a general similarity between them. The vigour of growth depends chiefly upon the fertility of the soil. The leaves are generally digitate, except in one case, when they are digitate partite, resembling *ganja* (*Cannabis sativa*). Chiefly for this reason, this variety is known as Ganja Tapioca. The tubers of this variety mature in six months. The period required for other kinds usually ranges from eight to twelve months.

The two main varieties are one sweet and one bitter. The latter contains a poisonous element, which can be got rid of by roasting or boiling, the water being poured away two or three times in the latter case.

Tapioca will grow in almost any kind of soil provided the climatic conditions are not too rigid. I have known it flourish up to an altitude of 2,000 feet. In fact, I believe, that it thrives better in Travancore on ordinary or inferior soil, with a little manure than on superior red land, where it needs constant watering. It is liable, however, to greatly exhaust the soil and render it unfit for cultivating the same or other crops unless heavily manured.

After selecting the land, it should be well ploughed. The soil selected in Travancore is usually of a porous character, where water cannot stagnate. The next process is the formation of ridges, three feet apart. Probably, however, pits 2' x 2' x 1' deep, three feet apart, are preferable. The pits should be filled with dried leaves, which should be burnt, as a precaution against white ants, and as a small instalment of manure. Ashes and other manures should be mixed with the soil. Ashes are, however, pre-eminently fitted to develop the tubers and ward off their insect enemies, which are numerous.

When the pit system is adopted, the pits should be so filled up with loose soil as to raise the centre of each to a height of seven or eight inches above the ordinary soil level. The raised portion of each mound should have a diameter of about one foot. In an acre there will be about 4,500 maunds. In the case of ridges, the planting should be at a distance of three feet.

Tapioca is propagated by means of cuttings from its stem, each cutting having at least three nodes. When the tubers are gathered, the stems are preserved for cuttings. These cuttings are planted in a slightly slanting position. Care should be taken not to plant them too deeply in the ground. Not more than three nodes should be underground. The cuttings should be put in when the ground is damp, or when rain is drizzling. There is no fixed time for planting in Travancore. The crop is cultivated throughout the year, with the exception of the dry months, December to February. In a week or ten days after planting, the cuttings begin to sprout, and the healthy sprigs can be distinguished from the unhealthy. Unnecessary sprigs should be removed. The soil should be slightly stirred and weeds removed occasionally.

In order to decide the time of harvest, the tubers of a few plants should be examined. If they appear to be mature, the crop should be dug up. After the tubers are gathered, the stems should be tied in small bundles and placed on the ground with the root end below, so that the capacity for germination may be retained.

The tubers will not keep long in their raw state. Within a week at most, they should be either sun-dried or boiled. If required for immediate consumption they are usually boiled, either alone or with tamarind leaves, the water being poured off two or three times. The tuber is also frequently reduced to powder, washed in clean water half a dozen times, pressed in a cloth and then dried in the sun, after which the flour will keep for a considerable period.

When required for storage or export, it is usually cut into slices and sun-dried after the thick outer skin has been removed. It is sometimes also boiled before being cut and sun dried.

The cost of cultivation per acre and value of yield will doubtless be of interest. I am here speaking of cultivation under ordinary circumstances. My estimate for preparing the land, manuring, planting the sets, weeding, interculture and harvesting is Rs. 130 per acre.

The value of the crop. Each plant may yield on an average 24 lbs. of tubers. Presuming that 4,000 are established per acre, the gross outturn might be 96,000 lbs. per acre, the value of which would be very considerable. At present, there has been a considerable fall in the price of Tapioca in Travancore, but after making ample allowance for this, and after allowing for interest on capital laid out to acquire the land, there is no doubt that a large profit can be secured.

It seems a great pity that advantage was not taken of the large stores of Tapioca in Travancore for the needs of the famine-stricken in North India. I understand that something has been done recently in introducing Tapioca from Travancore in the famine districts of Northern India, by the Salvation Army. There is also a small trade in Tapioca flour with Great Britain.

NOTES.

THE FOLLOWING MEMORANDUM HAS BEEN ISSUED BY PROFESSOR ROBERT WALLACE, PROFESSOR OF AGRICULTURE AND RURAL ECONOMY, EDINBURGH UNIVERSITY. Memorandum dealing with a Scheme for the Establishment of an *International Institute of Research*.

1. The fundamental object of the proposed organisation is primarily to develop the resources of the Commonwealths of Greater Britain and America, but ultimately to extend to all countries and benefit all sections of the human race by the conservation of the world's natural resources.

2. The fundamental means to be employed to be that of *physical research* in the widest sense, in contradistinction to *library research*, such as will mainly engage the attention of the International Institute of Agriculture at Rome.

3. The subjects to be taken up to be unrestricted as to classification, but to involve objects of international interest and importance, subjects which could not—on account of their magnitude, and, it might be in some cases, on account of the geographical distribution of the material to be investigated—be, in certain of their phases, so fully and comprehensively treated by one nation as by the combined efforts of two or more working together.

4. Although enlisting the sympathy and moral support of the respective governmental authorities, the work to be exclusively scientific and practical, free from all political questions and considerations, and to be conducted by highly trained experts, working under the general direction of a Board of Controllers, composed of the most prominent scientific men of the combined countries, to be chosen periodically.

5. The work not to interfere with that being done by the respective Government Departments of the included countries and their colonies and dependencies, and by institutions established for specific purposes, such as the Carnegie Institution of Washington; the International Fisheries Congress; the International Meteorological Committee; the International Association of Forest Experiment Stations; the International Congress for the Repression of Frauds in Foods and Drugs, and other similar bodies. But powers to be assumed to act in concert with, or through any of these or other bodies when it is deemed advantageous to do so.

6. The following intentionally restricted list of subjects will indicate a few of the directions in which research of an international kind could be instituted when, in the opinion of the controlling body of international representatives, the time is ripe for taking them up :—

- (a) Sea fisheries generally, but especially in relation to the study of pelagic species ranging widely over the ocean, which can only be undertaken by an international body having free access to every necessary centre of investigation dominated by the associated countries.
- (b) Atmospheric researches on a more comprehensive basis than that of existing Weather Bureaux in the interests of commerce and of agriculture, including the great branches of the live stock industry.
- (c) Researches bearing upon international quarantine of human beings and of the lower animals, and directed against plant diseases and insect pests, inclusive of their parasitic enemies.
- (d) International food and drugs' distribution.
- (e) The means of preventing the enormous waste in the utilisation of forest products.
- (f) The future possible sources of motive power to do the world's work when the present sources of power

become exhausted or too expensive, namely, conservation of sun energy, and the utilisation of wind, wave, and tide power.

The widest possible basis has been suggested for the functions of this International Institute of Research, because it is intended to be a permanent institution crowning and co-ordinating the work of other institutions by providing means to carry scientific research to a higher level and into a sphere of greater usefulness: consequently enlisting the practical sympathy and support of all classes of citizens.

8. The first controlling body should consist of ten distinguished scientists, which may be subsequently added to—one half nominated by representative authorities of each of the two initiating countries—each member, after preliminary adjustments, to hold office for five years. The Chairman or President should be an additional member, nominated each year by the country in which the meeting is held, and be one of the highest authorities on International Law.

9. The head office should have a central home in London and in Washington, under the direction of a permanent Executive Secretary and an Assistant Secretary.

10. The work, according to its nature, to be carried on wherever the Institute shall determine, and in the manner which it shall appoint.

11. Suggestions as to subjects to be taken up to be invited from all publicly constituted scientific and other bodies, accompanied by a detailed statement of the objects in view, with all other necessary information.*

12. Besides Central and Local Meetings of Committees, there should be at least one annual peripatetic meeting, at which all the members of the supreme body should be present, held at

* Regulations limiting proposals to purely international objects, and necessitating their full consideration and support by groups of public bodies, or societies devoted to common objects, before being submitted, would be necessary to keep the number of propositions within workable bounds.

some convenient place to be selected, at least once a year in advance, in the associated countries.

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IMPROVEMENT OF SERICULTURE IN BENGAL.—The following short note will show to those who are interested in the silk industry what the Bengal Silk Committee has done to stamp out the chief disease of the silk-worm. Pebrine, as this disease is known, has been the ruin of many poor *raiyats*, and the consequence has been that the cultivation of mulberry and the rearing of silk-worms have been reduced in many places.

The first thing that is done is to select the seed-cocoons carefully. And in this selection, the two following points are considered :

- (a) The two ends of the cocoons are hard.
- (b) The lesser the quantity of floss silk of a cocoon, the harder and better it is.

The moths of each crop are examined minutely after five days of their cutting out, and laying of the eggs, to see if they are free from disease. The worms from this seed are reared thinly in a mud hut where the temperature is regulated. This work is being carried on at the Central Baboolbona nursery. Successive careful selections of seed-cocoons since the erection of this nursery have made it possible to stamp out pebrine almost entirely. At present the Nistri seed is less than 1 per cent. pebrinized, and the Deshi which is naturally weaker and more liable to disease, is almost 1 per cent. pebrinized, whereas when the Bengal Silk Committee began the work some three years ago, the Nistri worms showed 50 per cent. pebrine and the Deshi worms almost cent. per cent. pebrine.

Seed (eggs) is distributed after the examination of the moths from the Baboolbona nursery to all the village nurseries from where pure or sound seed-cocoons are sold to the *raiyats*.

The Bengal Silk Committee's nurseries pay their own costs. If the zemindars of all the silk-worm rearing districts in Benga

would help the *raiyats* by starting at least one nursery on the model of the Silk Committee's nurseries, they would themselves be benefited. For with the improvement in the silk industry there would be an increase of mulberry cultivation, and for mulberry lands the rent obtained is generally four to six times higher than that obtained for lands cultivated otherwise. The opening of improved nurseries would also result in the re-establishment of reeling factories, which have been closed on account of the deterioration of seed-cocoons, and thus occupation would be found for many who, since the closing of these factories, have either been reduced to beggary or have found their way to prison.

It is a matter of great encouragement that the Maharaja of Coosimbazar in Marshidabad proposes to start a Central nursery with some subordinate nurseries, and to lay out mulberry plantations estimated at a cost of a lakh of rupees, and it is hoped that other zamindars will also follow the good example set by the Maharaja. (A. K. GHOSH).

THE SANGAMNER AGRICULTURAL SHOW.—A District Agricultural Show was held from the 27th to the 29th February 1908, at Sangamner, in Ahmednagar District of the Bombay Presidency. The Show consisted of four main parts, a Cattle Show, a comparative exhibition by cultivators, a small exhibition of selected seeds and implements by the Agricultural Department and a series of lectures and demonstrations. There was very healthy co-operation between the Committee of the Local Agricultural Association and the Superior Officers of the Agricultural Department. The judging committees were composed of leading Patels (village headmen). The comparative exhibition of produce by cultivators showed great care in selection and arrangement. The subjects of lectures delivered by the District Officers as well as the Officers of the Agricultural Department were suggested by the Association Committee. This Show was very successful in point of reaching the cultivators. Of the visitors numbering about 2,000, ninety per cent. were cultivators. —(EDITOR).

LIFT IRRIGATION IN THE BOMBAY PRESIDENCY. The Government of Bombay have decided to grant *Tupai* to persons desirous of erecting mechanical pumping installations on any river or stream in the Presidency, and to charge no royalty on the water for a period of 25 years. Facilities for training fitters to keep such installations in order, have been made available at the Victoria Jubilee Institute, Bombay, at the College of Science, Poona, and at the Methodist Episcopal Industrial Mission School, Nadiad. The services of a mechanic on Rs. 200, and a workman on Rs. 40 a month, have been placed at the disposal of the Provincial Director of Agriculture for the purpose of providing expert advice and assistance to agriculturists in connection with the use of mechanical pumps. The question of appointing a duly qualified Agricultural Engineer, to undertake work in connection with the investigation of waterlifting, of well-boring, and of the introduction and use of agricultural machinery, is still under the consideration of the Government. (EDITOR).

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RINDERPEST IN BOMBAY. The report on the outbreak of rinderpest in the Bombay Presidency for the year ending 31st December 1907, shows that the disease has affected every district in that Presidency. This year 55,763 animals were attacked, of which 26,002 died; whereas last year there were 35,286 attacks and 19,700 deaths. The only redeeming feature was a slight reduction in percentage of deaths to attacks during 1907. This was probably due to abatement of the virulence of the disease and the effects of inoculation. There was decreased mortality in all the districts where the cattle were inoculated. The inoculators having gained experience in their work, there were fewer deaths after inoculation than in previous years, the percentage of deaths among inoculated cattle being 1.41 as against 2.25 in the previous year. — (EDITOR).

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SHILLONG SHOW OF GARDEN AND FIELD PRODUCE. — The annual show of garden and field produce was this year held at Shillong, in the compound of the European School, on the 15th

and 14th May 1908. There was a large attendance of spectators on both days. Owing to the drought which had prevailed for some months before the show, neither vegetables nor flowers were as good as they usually are in the Khasi Hills in the middle of May, but there were good specimens of many vegetables, some fruits and dairy produce. There was a good show of poultry and eggs, and it is believed that measures for the improvement of the local breeds of fowls will be welcomed by the people.—(Editor).

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EGYPTIAN COTTON IN SIND. —In the last April issue of the *Agricultural Journal of India* (page 172), Mr. Henderson gave a short account of the trials of Egyptian cotton in Sind and of the results of Government auctions in facilitating the disposal of the cotton. The Bombay Government have since published a detailed report upon the working of the scheme of Government auctions at Mirpurkhas during 1907-08. The total number of maunds auctioned was 5,433 (against 4,879 in 1906-07), and the total sum realised was Rs. 62,754 (against 57,700 in 1906-07). Both Abassi and Metatifi varieties were put up for sale this year. There was very little demand in the beginning for the Metatifi. Abassi obtained a price varying from Rs. 11-12-0 to Rs. 14-2-6 per maund, and Metatifi from Rs. 11 to Rs. 11-12-3. The deductions made by Government for transport, etc., varied from Re. 1-6-6 to 7 annas per maund. The chief buyers were representatives of Ahmedabad and Bombay mills, and one or two exporting firms. It is also reported that samples were purchased for shipment to Japan.

It is estimated that under a fourth of the total outturn of the cotton was sent into the Government auctions: the rest was disposed of by the cultivators privately. The deductions made by Government from the prices realised may have deterred many cultivators from sending their cotton to the Government Dépôt. The prices obtained by private sale were fairly adequate as they were largely regulated by those obtained at the Government auctions. However, cultivators who had a stock of cotton after

the last auction was over, could not dispose of it at a good price. As satisfactory results were obtained from auctions held in the last season, the Bombay Government has sanctioned the proposal to continue them for another year. --(EDITOR).

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DEGUMMING OF RHEA FIBRE. —Many enquiries have been made as to the new process said to have been invented in India for degumming Ramie fibre. As far as we are aware, no such process seems to have been invented in India, but some such discovery by Mr. W. McGregor Smith, of Shanghai, was reported in the *Indian Trade Journal* of 26th December 1907. A copy of an extract from this Journal is given below for the information of our readers.

"The great difficulty hitherto in connection with the use of Ramie for textile purposes has been the softening and degumming of the fibre, which has rendered it almost impossible to weave a pure Ramie warp. A process has recently been discovered by Mr. W. McGregor Smith, Shanghai, by means of which, it is reported, the Ramie fibre becomes a soft filasse superior to cotton yarn and very much like silk. The process lasts but ten minutes (says the *Shanghai Mercury* in its report of a demonstration by the inventor), and is most simple. The machine is first placed in a vessel containing boiling water, to which is added some composition, the recipe for which is kept secret, and after boiling four and one half minutes it is washed, bleached and thoroughly degummed. The fibre comes out almost snow-white and is very much like silk. The fibre is not in the least injured by the process, but rather strengthened."

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BOARD OF VETERINARY SCIENCE IN INDIA. —The Government of India, encouraged at the success of the Board of Agriculture in India, suggested that a Board of Veterinary Science be instituted on similar lines. Accordingly the first meeting of the Board of Veterinary Science in India was held at Calcutta on the 10th, 11th and 12th February 1908, under the presidency of the **Inspector-General, Civil Veterinary Department.** Fifteen members

and eight visitors attended the Board. The Agricultural Departments were sufficiently represented.

It was decided that the meeting of the Board should be held once at least in three years, and the Government of India should fix the time and place of meeting. It was observed that the present staff is not sufficient for the suppression of cattle diseases in India, and that it should be strengthened, especially the staff of the Imperial Bacteriological Laboratory. On the outbreak of more important diseases, it was agreed that the Bacteriological Department ought to indicate to Provincial Superintendents the points on which information was required. The Board recommended that an advanced course for a fourth year in English should be added to the curriculum of one or more of the existing Veterinary Colleges, for the training of Deputy Superintendents and Veterinary Inspectors. It was considered necessary to improve the facilities for educating Indians in Veterinary Science by the appointment of an additional Professor of Pathology in each College. The Board agreed that the manuscripts of articles or books on purely veterinary and technical matters by the Officers of the Department should, before publication, be sent for approval to the Inspector-General, Civil Veterinary Department.

—(EDITOR)

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WELL-BORING IN CHINGLEPUT DISTRICT, MADRAS PRESIDENCY.—The well-boring operations in Chingleput have revealed very large supplies of subterranean water in the district. The number of borings put down from the commencement of operations up to the 31st December 1907, comes to 94 for new wells and 122 in old wells, of which 46 and 56 respectively proved successful. The *ryots* are sinking new wells and improving the supplies in the old ones with the assistance of Government loans, but the rate at which improvements are effected is slow. Mr. Chatterton attributes this to lack of energy, want of capital on the part of the *ryot* and to the local rules for State Loans. The Madras Government think of removing this last obstacle by amending the rules. (EDITOR).

NOTE ON THE GROWING OF TOBACCO IN INDIA FOR THE EUROPEAN MARKET.—Out of a total area of 220,000,000 acres under crops in British India and Native States, over one million acres are under tobacco. This figure is probably well under the mark. No statistics are at hand to show the value of this crop, but if we take the figure of £5 or Rs. 75 per acre as representing the gross yield, we have a trade equal to over 5 million pounds sterling, which would bring it into the fifth or sixth position of importance among the crops of India.

The varieties, whatever their origin, are mostly of the native type and cannot be classed commercially with any of the well-known cigar and pipe tobaccos of other countries. Only the varieties grown in Coimbatore, and probably Rangpur, are at all fit for European consumption. The amount taken up by this trade is comparatively small and scarcely affects the total figures. If it were possible to introduce into India a better tobacco plant and improve the present methods of growing and curing so as to produce tobacco suited to the European demand, the value of the crop would be enhanced enormously and an export trade would be created which would in all probability rank of first importance. The climate and soil of many parts of India have proved themselves eminently adapted to the growth of the tobacco plant, and the writer has witnessed results which, from the agricultural aspect, left nothing to be desired. How is it, then, that the country has so far failed to produce a high-grade product? The reasons appear to be two. First, the plant commonly grown in India is a degenerated specimen, too coarse for the European market, and secondly, the curing methods adopted are too crude and primitive to make even a good leaf into good tobacco. The first defect is not difficult to remedy as will be explained below, for good quality varieties of exotic tobaccos can be grown in India with success. The second defect, that of curing, is really the one difficulty which, in the opinion of the writer, stands in the way of improvement. In foreign countries where this crop is grown with success, the climate is also suited to the curing. In India this is just the opposite. Though the crop will grow well

the climate is such that the curing is extremely difficult. In the one case you have a warm, humid atmosphere giving the correct amount of heat and moisture night and day, so that the process is performed in the best manner under *natural* conditions. In India the natural conditions are, as a rule, positively hostile to good curing, for the climate is too dry, and the fermentative changes required do not take place. That being the case, the remedy seems to lie in the introduction of artificial means under which *optimum* conditions of combined heat and moisture can be supplied. If this were done, there can be little doubt that India would soon come into line with other tobacco-growing countries of the world.

The writer has experimented with many varieties of tobacco both at Pusa and Dalsing Sarai. Some 25 kinds of exotics were introduced. The majority had to be discarded as being entirely unsuited for growth in this climate. Some six varieties remained, of which one known as Zimmer's Spanish showed itself superior to all the others, and has been appreciated and retained by ordinary cultivators. It is well suited to the soil and climate of Behar and would probably do equally well in other parts of India. The yield obtained from this variety in 1901 at Dalsing Sarai was 1.8 to lbs. of dried leaves per acre. When attempts were made to cure the crop, the difficulties enumerated above became apparent. The climate was so dry that it was found impossible to handle it once it had been housed, and the required fermentation consequently could not proceed. At that time artificial means of control were not available, and the experiment had to be abandoned. This year the same variety is being grown at Pusa where provision is being made to entirely control the drying and curing process by artificial means, the results of which will be awaited with interest.—(BERNARD COVENTRY).

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A COMPARATIVE TEST BETWEEN AN IRON AND WOODEN SUGARCANE MILL. Through the courtesy of the late Mr. Minchin of the Aska Factory, a comparative test of the iron and wooden sugar mills used in the Ganjam district was held at Aska last

March with a view to ascertain the differences in the jaggery produced.

The mills were both, of the two-roller type worked by a pair of buffaloes. The iron mill was not a particularly efficient machine, as will be evident from the fact that the canes were put through twice: the same process was adopted with the wooden mill.



FIG. 8. Wooden Sugarcane Mill.

The two mills were erected side by side and work was started by first passing some canes through each mill to remove any accumulation of dirt that might have had an effect on the juice. The canes fed to each mill were picked at random from a single heap: the top few joints were cut off. Both mills worked simultaneously, and the boilings were carried out by an expert boiler under personal supervision. Four pot fulls of juice were obtained from each mill, and the crushed canes were then put through again, the second lot of juice being added to the first, and the whole thoroughly mixed and strained before sampling. The jaggery was not boiled down in a pan, this not being the custom in this district, but the juice was kept boiling in a number

of pots, the last of which where evaporation is allowed to proceed furthest, being replenished from time to time. The juice is turned out while still just viscid into a small earthenware vessel and allowed to harden. A little oil is added to check the formation of froth. The density of the juices was roughly determined and was found to be as follows :

Iron mill	first crushing	...	...	...	...	16
ditto	second	...	...	...	...	15
Wooden mill	first	...	...	...	...	14
ditto	second	...	...	...	...	15

The juice from the wooden mill was visibly darker in colour and contained more floating impurities. It was slightly more acid to litmus paper.

The juice was boiled on the 1st March. The jaggeries were not examined until the 15th April. There were four samples, two from each mill, lined and unlined respectively. They were analysed by the Madras Agricultural Chemist with the following results

	IRON MILL.		WOODEN MILL.	
	First.	Unlined.	Lined.	Unlined.
Sucrose	88.40	86.00	90.60	79.20
Glucose	5.00	9.44	3.65	8.09
Moisture	3.22	6.52	2.52	7.42
Ash	1.32	1.78	1.20	.88
Total	97.94	97.74	97.97	97.19

There were very marked differences in the appearances of the samples which bear out the differences indicated by the above figures. The pots had to be packed up before they were properly hard; both the lined samples had, however, dried enough to enable them to keep their shape. The jaggery in the two unlined pots had flowed from the bottom all round the sides; this difference in dryness was evident even when the pots were examined on the 15th April. That from the wooden mill was, however, very much stickier than the iron mill sample, though it actually contained less glucose. The iron mill sample had crystallised fairly well throughout and had drained well;

the wooden mill sample had, on the other hand, practically not drained at all. These differences may be due to differences in the degree of boiling.

The lined samples are both much better; both had freely crystallised, and both were well drained; the grain of the iron mill sugar was a little finer and a little darker in colour.

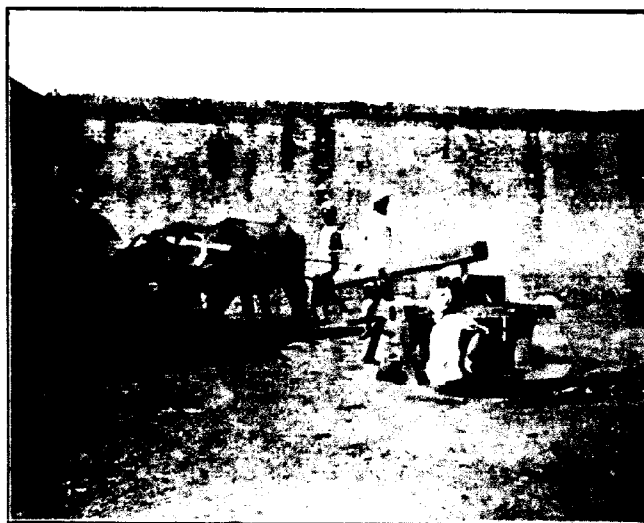


FIG. 9. Iron Sugar-mill.

A comparison of these facts shows that though the iron mill does its work so much more effectively, yet the quality of the jaggery made from the juice expressed by it is not so good. The extra crushing introduces impurities and gives a more acid juice, tending to produce a higher glucose content. The supposition that the small amount of lime added was not sufficient to neutralise the more acid juice, *i.e.*, that expressed from the iron mill, though it neutralised the wooden mill juice, will explain the relatively greater differences seen in the lined samples.

The colour of the jaggeries was in the order of their sucrose content. It was this question which really led to the test being made, as the *Aska* *ryot* objects to the iron mill on the ground that he gets a darker jaggery which the native refiners, who treat a great deal of the sugar produced in this district, do not like.

His objection is based on facts, but the quicker and more efficient work turned out by the iron mill will undoubtedly be found economical and should lead to its adoption.—(R. W. B. C. Wood).

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OIL-ENGINE AND PUMP IN THE TELINKHERI GARDENS AT NAGPUR. In May 1906, an oil-engine of 5 B.H.P., with a 2" centrifugal pump was set up at a well 30 feet deep in the Telinkheri Gardens, Nagpur. During May and June, when the pump was worked, the depth to water from the soil surface was 14 feet. The engine was found to empty a depth of 9 feet of water in $3\frac{1}{2}$ hours. It was only possible to work the pump $3\frac{1}{2}$ hours in the morning and $2\frac{1}{2}$ hours in the afternoon, as the well was emptied in these times.

The cost of working this engine and pump per day was as follows :—

Engine	...	...	...	...	Rs. 0 8
Coolie	...	...	...	...	" 0 4
Kerosine	...	...	...	...	" 2 14
Lubricating oil	...	...	...	...	" 0 4
					Rs. 3 14

If the depreciation of the machinery is added to this at the rate of 10 per cent. on the initial outlay and interest at 4 per cent. on the same, the total cost comes to Rs. 4-8-7. 6,480 gallons were raised to a height of 19 feet per hour or 38,880 gallons per day of six hours. On an average, the number of gallons that was raised per anna is, therefore, 535 gallons. A *mote* worked by a pair of bullocks can raise 56 *motas* or $56 \times 30 = 1,680$ gallons per hour from the same well, when worked continuously. One pair of bullocks can do steady work for six or more hours a day and can therefore, at the least, raise 10,080 gallons per day. The approximate cost in this case will be as shown below :—

Food for bullocks	...	...	...	As. 8
Wages of a coolie	...	...	...	" 4
Depreciation and interest on capital outlay	...	...	...	" 2
				As. 14

The cost of lifting water by a *mote* from this particular well is, therefore, 720 gallons per anna, or 185 gallons more than can be raised by the oil-engine per anna.

Although reduction can be made in the cost of pumping by the substitution of the cheaper oil known as liquid fuel for kerosine, still it should be stated that oil-engines can only be economically used where the supply of water is sufficient to keep them working for ten hours a day. — (EDITOR).

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FLAX IN BEHAR. — Mr Vanderkerkhove, the Belgian Flax Expert, took home some flax straw of fine quality, grown at the Dooriah Factory, with the object of retting it in the River Lys. The result of his experiment was most satisfactory. The dry straw yielded 22 per cent. of fibre and 5 to 6 per cent. of tow. These outturns compare well with the highest returns of Belgium flax. — (EDITOR).

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THE APPLICATION OF THE METHODS OF DRY-FARMING TO THE AGRICULTURE OF SEMI-ARID TRACTS IN INDIA. Methods of dry farming have made the successful cultivation of crops possible in the semi-arid tracts of the United States of America in places where the annual rainfall is not more than 12 inches. The system depends for its success on thorough tillage which helps to retain the rainfall as it falls on the land.

In the semi-arid Districts, the loss of moisture from bare fields after the harvesting of crops is believed to be greater than at any other time. If the land is ploughed during dry hot weather and is allowed to remain loose as left by the plough, there will be a great loss of moisture. Deep ploughing is desirable, but to avoid loss of moisture at any season it is advisable to produce a finely pulverised surface by harrowing or otherwise, and thereby also somewhat consolidate the soil beneath. The upper layer should be kept continuously friable by tillage. By deep ploughing, the soil can store the rain that falls. If a crust is allowed to form on the surface, evaporation from the soil will be greatly increased.

It is advisable to sow seed evenly by drilling it and to pack the soil around the seed.

In India, after sowing, interculture with a bullock hoe is of great advantage, and especially after every fall of rain, as soon as the surface soil becomes fairly dry and usually until the crop gets a foot high.

There are some varieties of cereals and of other crops that are particularly drought-resisting, and their cultivation lends itself to dry-farming.

It is well known in India that 12 inches of rainfall, if well distributed, are sufficient to mature certain cereal crops, but we would like a heavier rainfall. Usually in Thar and Parkar on the border of the Sind desert, cultivation of ordinary dry crops is fairly successful. In the Deccan too, it has been found that this amount of rainfall in the *Kharif* or *Rabi* season is fairly sufficient for some cereals.

With a view to test the efficacy of the system of dry-farming in the semi-arid tracts of the Bombay Presidency, the Agricultural Department has obtained the seed of 22 drought-resisting varieties of cereals and other crops and arranged for special cultivation. Twenty-five acres of land have been acquired in the Ahmednagar District for experiments which are chiefly as follows

- I. Increasing the capacity of soil to store water by—
 - (a) deeper and more thorough preparatory tillage ;
 - (b) firming the under soil by a sub-soil packer and roller.
- II. Preventing evaporation by inter-tillage.
- III. By spacing the number of plants per acre.
- IV. Assisting germination by—
 - (a) moistening seed ;
 - (b) firming after planting.
- V. Increasing the amount of stored water by impounding it within embankments.—(EDITOR).

FOURTH CATTLE SHOW AT ONGOLE.—The Show opened on the 14th March 1908 and extended over two days and was a good one. It was managed by the local Agricultural Association with Government help. The Ongole cattle breed is one of the few best in India. Some bulls of this breed were last year exported to South America, and this trade should be encouraged. It must bring the breed into favour and raise prices. The best bull exhibited was sold for Rs. 350.

In order that the breed may be maintained at a high standard, Government purchased six of the best bulls and sent them to the Guntur District.

The chief other features of the Show were (a) the delivery of lectures on cattle-breeding and Agricultural subjects; (b) the exhibition of Agricultural and Forest products; and (c) the exhibition of fibre extracted from indigenous plants. (Editor).



THE TOLERANCE OF PLANTS FOR SALTS IN ALKALI SOILS. Kearney and Harter of the United States Department of Agriculture in the Bureau of Plant Industry publish some very interesting results (Bulletin No. 113) on the tolerance of plants for salts in alkali soils. They clearly show that different genera and species of plant differ greatly in their power of resistance to alkali salts; also marked differences in resistance are shown between individual plants of the same species. Thus, there seems a possibility of selecting strains of plants fairly resistant to alkali salts. The results may therefore be of interest to those who have to deal with alkali soils in India.

They conclude their paper with the following summary:

- (1) Different varieties of the same species, *e.g.*, of wheat, sorghum, and oats, differ considerably in their powers of resistance to the action of magnesium and sodium salts in pure solutions.
- (2) Closely related species of the same genus, *e.g.*, Egyptian and Upland cottons show similar differences.
- (3) Great differences exist between different plant species, even when belonging to the same family, in tolerance of pure

salt solutions not only as regards the absolute toxicity of each salt, but also as regards the relative order of toxicity of the salts. Of the 8 species used in these experiments, maize is on the whole the most resistant of pure solutions, and cotton the least.

(4) Seedlings grown from fresh seeds are much more resistant than those developed from older seed.

(5) The presence of calcium in excess greatly diminishes the toxicity of the magnesium and sodium salts to all the plants tested, the neutralising effect being greatest in the case of sulphate of magnesium and least in that of sodium carbonate.

(6) The addition of calcium sulphate tends to equalise the toxicity of the different magnesium and sodium salts.

(7) As a rule, the more sensitive the species to the pure solution, the greater is the counteracting effect of the calcium salt; hence the presence of the latter tends to diminish the differences in the resistance shown by different plant species in the presence of pure solutions.

(8) Amounts of calcium sulphate smaller than that necessary to saturate the mixed solution also show a marked neutralising effect upon the more toxic salts, but the minimum amount of calcium sulphate capable of producing such effect remains to be determined.

(9) For the white lupine the presence of 0.5 grain of calcium sulphate is as effective as seven times that amount in neutralising sodium chloride, while for sorghum 0.1 grain is as effective as twenty times that amount.

(10) To secure the most effective possible neutralization of sodium chloride, five times as much calcium sulphate is required in the case of the white lupine as in that of sorghum, although the limits for these two plants are approximately the same both in pure sodium chloride and in sodium chloride plus an excess of calcium sulphate.

(11) While the comparative resistance of the different plants to pure solutions of the single salts can in no way be correlated with that of the same species to the different combinations of "alkali" salts occurring in Western soils, their

behaviour in mixed solutions shows a much closer approach to that observed under natural conditions.—(H. E. ANNETT).

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RAT POISON.—The Punjab Medical Department have tested a poison for rats. It is said to be efficient. The poison is supplied by the Inspector-General of Civil Hospitals, Punjab, Lahore, at 12 annas a tin. A tin contains about nine ounces of the stuff, sufficient for about sixteen hundred baits. Each bait is fatal to a rat in less than 48 hours. The contents of one tin should be added to one seer of *guc* (crude sugar) and thoroughly mixed, sufficient *ata* (wheat flour) being added to make a stiff paste. This mass is then divided into 1,600 large pills. Detailed information regarding the composition, manufacture and use of the poison can be obtained from the Inspector-General of Civil Hospitals, Punjab, Lahore.—(EDITOR).

REPORT OF THE PATNA DIVISIONAL AGRICULTURAL ASSOCIATION, 1907-08.—The report covers the period from the beginning of July 1907 to the end of June 1908. This Association has an annual Industrial and Agricultural Exhibition. One member, who undertook the experimental cultivation of jute in South Behar, has succeeded in producing fibre of good quality. Encouraged by this success, the Association has distributed some jute seed. The Association also endeavoured to introduce a fine variety of *Aus* paddy. The cultivation of Dharwar American Cotton with an outturn of 6 maunds per acre is referred to. Another successful introduction into the Patna Division is of *Sialu* (winter) Jowar of the Bombay Presidency. Note is also taken of the trials made with foreign implements. The Rajeshwar Plough and Albion Reaper were found to be suitable. The Association obtains from the Civil Veterinary Department, Bengal, advice in veterinary matters. The distribution of good seed of ordinary crops is making progress. It is proposed to modify the system of membership of the Association and to enroll intelligent cultivators as members. The Association

invited 50 cultivators of the Patna District to the last Industrial and Agricultural Exhibition at Bankipur where lectures on agricultural subjects were given.—(EDITOR).

THE FOOD OF THE PEOPLE IN TIMES OF SCARCITY, UPPER BURMA.—Rain is scarce and capricious in the dry zone of Upper Burma, and averages about 27 inches a year, falling as low as 12 or 15 inches in many places and seldom rising above 35 or 40 inches. The immediate consequences are drought and scarcity of food and water. The mainstay of the population in the affected districts is, generally, their cattle which in bad seasons they take down to Lower Burma, and sell, buying rice and other necessities with the money realized. But, besides the resources afforded by the sale of cattle, the population find other means of subsistence in various yams, tubers, roots and nuts which are dug up or gathered in the jungles.

Of tubers, the most common are the bulbs of the *Dioscorea alata*, known in Burmese as "Kywe-u," and of the *Dioscorea alata*, called "Myauk-u". Fortunately, these are common all over the dry zone. It is a general belief among Burmese jungle folk that these sprout up only in bad seasons. The truth is, of course, that at other times these wild tubers are not sought for. The tubers are first cut up in slices and soaked for some time in two or three changes of cold water, and then boiled in the ordinary way.

Another wild tuber, the bulb of the "Samidauk," the *Gloriosa superba*, is sometimes eaten. But a soaking in several changes of water for twelve consecutive hours, at least, is necessary to remove a poisonous principle, the tubers having been previously cut up in thin slices.

Amongst other food stuffs consumed in times of scarcity, when rice and other staples are scarce, we must note the roots of the toddy-tree, the "Htan-bin" (*Borassus flabellifer*), of the cocoanut tree, "On-bin" (*Cocos nucifera*), and of the "Pebin" (*Corypha umbraculifera*), also the tender new shoots called "Hmyit" of the common Upper Burma bamboo tree (*Dendro-*

calamus strictus) which sprout in May and June after the first showers of rain.

Another article of food, little known at present, is the Burmese "Lanzan," the nut kernel of the "Lanbin" or *Buchanania glabra*, a forest tree which grows wild throughout the dry zone of Upper Burma and is common in the districts of Pakokku, Minbu, Magwe and Myingyan. It is eaten in the raw state or after being roasted or fried. Lanzan can be obtained at Pakokku, Yenangyat, Seikpyu and in the Yaw Valley, in the Pakokku District, at Zibyubin and Sinbyugyum in the Minbu District, at Yenangyaung and Magwe District, and probably throughout the dry zone of Upper Burma. It might in time become a valuable article of trade.—(LEON AUBERT).

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BEES IN COORG.—There are two kinds of honey bees in Coorg, the large and the small. The former are not domesticated. Their nests are found on high trees, preferably *Lagerstrœmia microcarpa*, and the wild mango tree, under the arches of bridges and public buildings and precipitous rocks. There is a hill in Coorg called Jain Kal Betta (Honey rock hill) where these bees have been settled from time immemorial. Their honey has an acid taste and is not much valued, but the wax is much sought after. It is a very difficult task to get at the hives, owing to the inaccessible position in which they are found. In Coorg the Jain Kurubas, a jungle tribe, are adepts at taking the honey.

The small bees are domesticated not by the Kurubas, but by ordinary ryots. A large earthen pot is smeared inside with bees' wax scented by rubbing the leaves of the wild cinnamon tree on the wax. About a dozen small holes, $\frac{1}{2}$ " in diameter are bored into the pot, and bees' wax scented by the wild cinnamon leaves is rubbed round the holes on the outside. The mouth of the pot is closed by tying a cloth over it, and it is then placed upside down in the jungle, in a shady place. In time the pot will usually be found to be inhabited by bees. The pot is then very cautiously removed at night and placed in a dry place

free from ants, facing the east under shades. Some people have a hundred or more pots in their farm-yard. The bees are not disturbed by the people of the household. No attention whatsoever is paid to them till about June when the honey is removed. As a rule, all the honey is taken, but some careful bee-keepers leave at least one comb in each pot. Some pots contain about a dozen combs, yielding about three seers of honey. The price of a seer is from four to six annas according to the season.—(G. HALLER).

PEAS AND BEANS GROWN IN BURMA.—There are about 26 varieties of peas and beans grown in Burma. The chief of these are the following:—*Crotalaria juncata*, Sann-hemp; *Cyamopsis psoraleoides* and *Arachis hypogea*, Pea nut; *Cicer arietinum*, Chicken pea or gram; *Lathyrus sativus* and *Pisum sativum* and *arvense*, Peas; *Glycine hispida*, Soy beans; *Catutradia cusiformis*, Sword bean; *Phaseolus mungo*, Mash-kalā; *Phaseolus radiatus*, Mung; *Phaseolus lunatus*, Lima bean; *Phaseolus calcaratus*, *Phaseolus ricciardianus*, *Phaseolus acutifolius* and *Phaseolus vulgaris*, Kidney bean; *Vigna catiangu*, *Pachyrhizus angulatus*, *Dolichos lablab*, *Dolichos biflorus* and *Cajanus indicus*, Pigeon pea, etc.

Crotalaria juncata, Sann-hemp, is grown in Central Burma to a very large extent. The fibre is used for making fishing nets.

It is not necessary to refer particularly to the other pulses which have been referred to as they are all common food grain crops in India, and their value as such is commonly known.—(EDITOR).

REVIEWS.

A SHORT NOTE ON A MONOGRAPH BY MR. D. QUINLAN, M.R.C.V.S.,
SUPERINTENDENT, CIVIL VETERINARY DEPARTMENT, BENGAL,
ON THE CATTLE AND AGRICULTURE OF THE DARJEELING
DISTRICT.

THE conditions of agriculture in different parts are exceedingly varied and difficult. The cultivators classify the soils into three heads—white, red and black : of these, the black soil is the richest and is more suitable for dry crops such as maize and *matua*. There has recently been great extension of cultivation especially in the Kalimpong tract, owing to the influx of Nepalese and Bhutia settlers. Till very recently the *kobali* or hand-spade was the chief implement used in tillage, but ploughs are now in use.

The steep hill-sides are terraced, and the arable crops are grown on these flat terraces. Irrigation is required at some seasons, and is obtained from small channels which are led from hill streams. The water has usually to be carried there from long distances.

The principal crops grown are rice and maize, which are sown in March and April and are harvested about December. Buck wheat is also extensively grown. Both wheat and barley are grown.

There is a great demand for good and hardy work-cattle, and for good milch cows. The principal grazing grounds are in the reserved forests. During the summer months, large numbers of cattle are sent by the *gaulus* (cowherds) up the mountains of Nepal and Sikkim. Oilcakes, either mustard or linseed, are largely used for food, particularly for cows and cart bullocks.

There are three distinct breeds of cattle in the district, (i) the *siri*, (ii) the Nepali or *Padhari*, and (iii) the ordinary zebu plains breed found in the Terai. Of these, the *siri* is the best cart breed, on account of size and strength, and the cows are good milkers generally. The Nepali are the common cattle of the district. They are largely imported by the Nepalese settlers, for cultivating their small fields.

The wild Mithun or *Gogol* is a large animal, is immensely powerful, and is caught and tamed for work by the Bhutia tribes.

The forests in which the cattle usually graze, produce good fodder. Stall feeding is seldom required.

Proposals have been made to start a cattle-breeding farm at Kalimpong.—(EDITOR).

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THIRD REPORT ON THE SUGAR MILL AT BENIPORE FACTORY.—BY PERCY JONES.—(PUBLISHED BY THE BEHAR PLANTERS' ASSOCIATION).

THE Behar Planters' Association have published a third report on the working of the Sugar Plant at Benipore (Tirhoot) in 1907-08. The Mill was worked during the past year at a profit of Rs. 2,365-1-0. Mr. Percy Jones ordered from Messrs. Broadbent & Co., a centrifugal machine of the pattern recommended by Mr. Hadi. It was, however, received late. It, therefore, began work with the *rub* after February the 15th. There was a large stock of *rub* on hand, which could not be worked off into sugar for nearly 1½ months. It had in that time settled and got hard, and so required more washing. This led to a loss of crystals.

The percentage of sugar obtained was very low, being only about 30 per cent. from the first quality *rub* and a little under that from molasses *rub*. However, with more experience a steady percentage of 33 per cent. first class quality of sugar was obtained. Mr. Jones could realise for this sugar from Rs. 9 to Rs. 10 per maund. Sugar inferior to this in quality was sold for about Rs. 6 a maund. Mr. Jones made several experiments in connection with the storage of *rub* and has found that shallow

tanks 6" deep on a masonry floor are the best. In these, the *rab* cools quickly, and is ready to be spun off on the fifth day.

Mr. Jones had to deal with a cane-crop which was badly attacked by borer insects. This year, he has imported unaffected cane. His labourers have gained experience, and he hopes to show better results next year --(EDITOR).

LIST OF AGRICULTURAL PUBLICATIONS IN INDIA DURING 1907-08.

No.	TITLE.	Author.	Where published.
<i>General Agriculture.</i>			
1	Annual Report of the Imperial Department of Agriculture in India for the years 1906-07 and 1906-07. Price, 6 annas.	Inspector General of Agriculture in India, Nagpur, Central Provinces.	Government Printing India, Calcutta.
2	Proceedings of the Board of Agriculture in India, 1908. Price 8 annas.	Ditto.	Ditto.
3	Agricultural Journal of India, Vol. III, Parts I, III. Price, Rs. 2 for each part. Annual Subscription, Rs. 6 per annum.	Agricultural Research Institute, Poona.	Messrs. Thacker, Spink & Co., Calcutta.
4	Standard Curriculum for Provincial Agricultural Colleges, as recommended by the Board of Agriculture. Price, 4 annas.	Inspector General of Agriculture in India, Nagpur, Central Provinces.	Government Printing India, Calcutta.
5	Indian Cotton Seed. Its Industrial Possibilities. Price, 12 annas.	Frederic Noel-Patton, Director General of Commercial Intelligence, India.	Ditto.
6	Proceedings of the Veterinary Conference held at Calcutta on the 10th, 11th and 12th February, 1908.	Inspector General, Civil Veterinary Department, Simla.	Ditto.
7	Agricultural Statistics of India, from 1901-1906-06. Price, Rs. 3.8.	Director General of Commercial Intelligence.	Ditto.
8	Sun Flower in India. Agricultural Ledger, Ledger No. 1, 1907. Price, 2 annas.	David Hooper, etc., etc., Superintendent, Industrial Section, Indian Museum, Calcutta.	Ditto.
9	Causes of hardness in the seeds of Indigofera arrecta.	C. J. Berghell, Imperial Bacteriologist, and D. Day.	Ditto.
10	Hooleoka Experimental Station. Investigations during 1905 and 1906.	Hartley H. Mann, B.Sc., F.R.S., Scientific Officer to the Indian Tea Association.	Indian Tea Association, Calcutta.
11	Second Report on the Sugar Mill at Benipur Factory.	Percy Jones.	Behar Planters' Association, Mozufferpore.
12	Annual Report of the Behar Planters' Association for 1906-1907.	Behar Planters' Association.	Ditto.
13	Report of the Indigo Research Station, Sirsah, for 1907-1908.	C. J. Berghell, Imperial Bacteriologist.	Ditto.
14	Third Annual Report of the Behar Planters' Association, Sirsah Sub-committee, from 1st July 1907 to 31st December 1907.	Behar Planters' Association.	Ditto.
15	Third Report on the Sugar Mill at Benipur Factory.	Percy Jones.	Ditto.

LIST OF AGRICULTURAL PUBLICATIONS DURING 1907-08.—(Continued).

No.	Title.	Author.	Where published.
<i>General Agriculture—contd.</i>			
16	Review of information on Burmese Peas and Beans so far collected in the office of the Reporter on Economic Products to the Government of India.	L. H. Burkill, M.A., Reporter on Economic Products to the Government of India.	Government Printing, India, Calcutta.
17	Conservation of Farm Yard manure. Leaflet No. 7 of 1907.	Department of Agriculture, Bengal.	Department of Agriculture, Bengal, Calcutta.
18	Fertilizer for paddy. Leaflet No. 8 of 1907.	Ditto.	Ditto.
19	Weeds and their Suppression. Leaflet No. 9 of 1907.	Ditto.	Ditto.
20	Bonemeal and Saltpetre as manure for paddy. Leaflet No. 10 of 1907.	C. A. Oldham, L.C.S., Director of Agriculture, Bengal.	Ditto.
21	Short note on the Cultivation of Mangel Wurzel. Leaflet No. 11 of 1907.	Ditto.	Ditto.
22	Cassava. Leaflet No. 12 of 1907.	Department of Agriculture, Bengal.	Ditto.
23	Short instructions for the Improvement of Cotton by plant to plant selection. Leaflet No. 13 of 1907.	C. A. Oldham, L.C.S., Director of Agriculture, Bengal.	Ditto.
24	Jute Experiments in Bengal. Leaflet No. 1 of 1908.	F. Smith, B.Sc., Deputy Director of Agriculture, Bengal.	Department of Agriculture, Bengal, Calcutta.
25	Oats. Leaflet No. 2 of 1908.	Ditto.	Ditto.
26	Wheat. Leaflet No. 3 of 1908.	Ditto.	Ditto.
27	List of crops recommended for cultivation. Leaflet No. 4 of 1908.	Ditto.	Ditto.
28	The Bengal Seed, Manure and Implement Store. Leaflet No. 5 of 1908.	Department of Agriculture, Bengal.	Ditto.
29	Quarterly Journal of the Agricultural Dept., Bengal, Vol. I, Nos. 1-4. Price, Rs. 2.	Ditto.	Bengal Secretariat Book Depot, Calcutta.
30	Annual Report of the Agricultural Department, Bengal, for the year ending 30th June 1907. Price, 8 annas.	Ditto.	Ditto.
31	Annual Report of the Bardwan Experimental Station for the year 1906-07. Price, 1 anna.	Ditto.	Ditto.
32	Annual Report of the Dumraon Experimental Station for the year 1906-07. Price, 2 annas.	Ditto.	Ditto.
33	Annual Report of the Cuttack Experimental Station for the year 1906-07. Price, 2 annas.	Ditto.	Ditto.
34	Season and Crop Report of Bengal, 1907-08. Price, 8 annas.	Ditto.	Ditto.
35	Agricultural Statistics of Bengal. Price, 8 annas.	Ditto.	Ditto.
36	Manual of Rules for the preparation of crop reports and Agricultural Statistics in Bengal (not for sale).	Ditto.	Bengal Secretariat Press, Calcutta.
37	Statement showing the normal areas under the principal crops in each district and the percentage of these areas on the normal net cropped area of the district (not for sale).	Ditto.	Ditto.

LIST OF AGRICULTURAL PUBLICATIONS DURING 1907-08.—(Continued).

No.	Title.	Author.	Where published.
<i>General Agriculture—contd.</i>			
38	Jute in Bengal	N. C. Chowdhry.	Muzumdar Library, Calcutta.
39	List of Local names of varieties and races of sugarcane grown in Bengal (not for sale).	Department of Agriculture, Bengal.	Bengal Secretariat Press, Calcutta.
40	A short note on wheat survey in Bengal. Departmental Record, No. 2 (not for sale).	D. N. Mukerji, M.A., M.B.A.S.	Ditto.
41	Catalogue of exhibits of the Bengal Agricultural Department in the Indian Industrial and Agricultural Exhibition 1906-07 (not for sale).	Department of Agriculture, Bengal.	Ditto.
42	Report on enquiry into the decline of the silk industry of Bengal.	Ditto.	Ditto.
43	Monograph on breeds of cattle of Darjeeling district (not for sale).	D. Quinlan, M.B.A.S., Superintendent, C. V. Dept., Bengal.	Ditto.
44	Report of the Patna Divisional Agricultural Association for the year ending 30th June, 1908.	Patna Divisional Agricultural Association	Patna Divisional Agricultural Association, Bankipore.
45	Annual Report on the Administration of the Department of Agriculture, United Provinces, for the year ending 30th June, 1907. Price, 8 annas.	Department of Agriculture, United Provinces of Agra and Oudh.	Government Press, United Provinces of Agra and Oudh, Allahabad.
46	Annual Report on the Cawnpur Agricultural Station for the year ending 30th June, 1907.	Ditto.	Ditto.
47	Annual Report on the Jalaun (Oran) Agricultural Station for the year ending 30th June, 1907. Price, 8 annas.	Ditto.	Ditto.
48	Annual Report of the Aligarh Agricultural Station for the year ending 30th June, 1907. Price, 8 annas.	Ditto.	Ditto.
49	Annual Report of the Department of Agriculture, Punjab for the year 1906-07. Price, 5 annas.	Department of Agriculture, Punjab.	"Civil & Military Gazette" Press, Lahore.
50	Annual Report of the Lyallpur Agricultural Station for the year 1906-07. Price, 6 annas.	Ditto.	Ditto.
51	Annual Report of the Government Agri Horticultural Gardens, Lahore, for the year 1907-08.	Ditto.	Ditto.
52	Season and Crop Report of the Punjab for 1906-07. Price, 9 annas.	Ditto.	Ditto.
53	Annual Report of the Department of Agriculture, Bombay Presidency, for the year 1906-07. Price, 4 annas.	Department of Agriculture, Bombay Presidency.	Government Central Press, Bombay.
54	Annual Report of the Experimental Work of the Surat Agricultural Station for the year 1906-07. Price, 6 annas.	Ditto.	Ditto.
55	Annual Report of the Experimental Work of the Nadiad Agricultural Station for the year 1906-07. Price, 6 annas.	Ditto.	Ditto.

LIST OF AGRICULTURAL PUBLICATIONS DURING 1907-08.—(Continued).

No.	Title.	Author.	Where Published.
<i>General Agriculture—contd.</i>			
56	Annual Report of the Experimental work of the Dharwar Agricultural Station for the year 1906-07. Price, 6 annas.	Department of Agriculture, Bombay Presidency.	Government Central Press, Bombay.
57	Annual Report of the Experimental work of the Dhulia Agricultural Station for the year 1906-07. Price, 4 annas.	Ditto.	Ditto.
58	Annual Report of the Poona Agricultural Station for the year 1906-07, including Kirkee Civil Dairy and Lamowli Agricultural Stations. Price, 7 annas.	Ditto.	Ditto.
59	Annual Report of the Manjri Agricultural Station and the Baramati Demonstration Station for the year 1906-07. Price, 5 annas.	Ditto.	Ditto.
60	Annual Report of the Ganeshkhind Botanical Station for the year 1906-07. Price, 5 annas.	Ditto.	Ditto.
61	Annual Report of the Bassein Botanical and Agricultural Station for the year 1906-07. Price, 4 annas.	Ditto.	Ditto.
62	Annual Report of the Mirpurkhas Agricultural Station for the year 1906-07. Price, 3 annas.	Ditto.	Ditto.
63	Season and Crop Report of the Bombay Presidency for the year 1906-07. Price, 7 annas.	Ditto.	Ditto.
64	Proceedings of the Agricultural Conference held at Ahmedabad in November 1907. Price, 7 annas.	Ditto.	Dit
65	Poona Agricultural College Calendar for the year 1908-09.	Ditto.	Shri Shetkari Press, Poona.
66	Report on the Operations of the Department of Agriculture for the year 1906-07. Price, 8 annas.	Department of Agriculture, Madras.	Government Press, Madras.
67	Scientific Report of the Attur Agricultural Station for the year 1906-07. Price, 2 annas.	Ditto.	Ditto.
68	Scientific Report of the Hazari Agricultural Station for the year 1906-07. Price, 4 annas.	Ditto.	Ditto.
69	Scientific Report of the Bellary Agricultural Station for the year 1906-07. Price, 6 annas.	Ditto.	Ditto.
70	Scientific Report of the Palur Agricultural Station for the year 1906-07. Price, 3 annas.	Ditto.	Ditto.
71	Scientific Report of the Kolpatti Agricultural Station for the year 1906-07. Price, 6 annas.	Ditto.	Ditto.
72	Scientific Report of the Samalkota Agricultural Station for the year 1906-07. Price, 3 annas.	Ditto.	Ditto.

LIST OF AGRICULTURAL PUBLICATIONS DURING 1907-08.—(Continued).

No.	Title	Author.	Where published.
<i>General Agriculture—contd.</i>			
73	Notes on Fig cultivation in South India and peculiarities in its culture in Penkonda in the Anantpur District. Bulletin No. 57. Price, 1 anna.	Rao Bahadur C. K. Subba Rao, B.A., Ag. Government Botanist, Madras.	Government Press, Madras.*
74	The cultivation of Groundnuts. Bulletin No. 58. Price 2 pies.	H. C. Sampson, B.Sc., Deputy Director of Agriculture, Southern Circle, Madras Presidency.	Ditto.
75	Note on Jute cultivation in Tanjore. Leaflet. Distributed free to ryots.	Ditto.	Ditto.
76	Madras Agricultural Calendar 1908. Price, 0.16.	Department of Agriculture, Madras.	Ditto.
77	Note on How to water fruit trees. Leaflet with Tamil and Telugu translations. Distributed free to ryots.	Ditto.	Ditto.
78	The introduction of improvements into Indian Agriculture. Leaflet.	D. Johnston, M.A., B.Sc., Deputy Director of Agriculture, Central Provinces.	Secretariat Press, Nagpur.
79	Sun hemp, Amaranth and Agave as fibre crops in the Central Provinces. Leaflet.	Ditto.	Ditto.
80	Scorpa Juice. Leaflet.	Ditto.	Decha Sevak Press, Nagpur.
81	Sesha. Leaflet.	Ditto.	Ditto.
82	Medium Paddy. Leaflet.	Ditto.	Ditto.
83	Raskatum and Nisook—early pulhies. Leaflet.	Ditto.	Ditto.
84	Gurmitra, late paddy. Leaflet.	Ditto.	Ditto.
85	Groundnut. Leaflet.	Ditto.	Ditto.
86	Upland Georgian and Bari Kapas. Leaflet.	Ditto.	Ditto.
87	Dry Earth Method of Conserving urine. Leaflet.	Ditto.	Ditto.
88	Agricultural Gazette. A monthly publication. Price, 2 annas per copy.	Ditto.	Ditto.
89	Hints to Superintendents of Experiment Stations.	Ditto.	Secretariat Press, Nagpur.
90	Report on the Department of Agriculture, Central Provinces. Price, Re. 1.	Department of Agriculture, Central Provinces.	Ditto.
91	Report on the Agricultural Stations in the Central Provinces. Price, Re. 1.	Ditto.	Ditto.
92	Report on the Provincial and District Gardens in the Central Provinces. Price, Re. 1.	Ditto.	Ditto.
93	Wheat grown in the Central Provinces. Bulletin, Price, Re. 1.	G. Evans, B.A., B.Sc., Deputy Director of Agriculture, Central Provinces.	Ditto.
94	A few simple Agricultural improvements. Bulletin No. 16 of 1907.	Rao Bahadur B. C. Basu M.A., B.A., Asst. Director of Agriculture, E. B. & Assam.	Eastern Bengal and Assam Secretariat Press, Shillong.
95	Jhum cultivation in Lushding. Bulletin No. 18 of 1908.	Ditto.	Ditto.
96	Coffee cultivation in the Khasi Hills. Bulletin No. 20 of 1908.	Ditto.	Ditto.

* With Tamil and Telugu translations.

LIST OF AGRICULTURAL PUBLICATIONS DURING 1907-08. — (Continued).

No.	Title.	Author.	Where published.
<i>General Agriculture—concl'd.</i>			
97	Jute cultivation. Leaflet No. 1 of 1907.	Robert S. Finlow, B. Sc., Fibre Expert to the Government of E. B. & Assam.	Eastern Bengal and Assam Secretariat Press, Shillong.*
98	Jute in rotation with paddy in the same year and its effect on food crops. Leaflet.	S. G. Hart, I.C.S., Director of Agriculture, E. B. & Assam.	Ditto.
99	Annual Report of the Department of Agriculture, E. B. and Assam, for 1906-07. Price, 8 annas.	Department of Agriculture, E. B. & Assam.	Ditto.
100	Annual Report on the Agricultural stations in Eastern Bengal & Assam for 1906-07. Price, 12 annas.	Ditto.	Ditto.
101	Annual Report of the Tropical Plantation at Wahjain for the year ending 30th June 1907. Price, 2 annas.	Ditto.	Ditto.
102	Annual Report of the Rajshahi Agricultural Station for 1906-07. Price, 2 annas.	Ditto.	Ditto.
103	Annual Report of the Rangpur Agricultural Station for 1906-07. Price, 2 annas.	Ditto.	Ditto.
104	Annual Report of the Jodhpur Agricultural Station for 1906-07. Price, 2 annas.	Ditto.	Ditto.
105	Annual Report of the Upper Shillong Agricultural Station for 1906-07. Price, 2 annas.	Ditto.	Ditto.
106	Annual Report of the Shillong Fruit Garden for 1906-07. Price, 2 annas.	Ditto.	Ditto.
107	Wheat cultivation. Leaflet No. 1.	Department of Agriculture, Burma.	Government Press, Burma, Rangoon.
108	Farmyard manure, Dong or cattle manure. Leaflet No. 3.	Ditto.	Ditto.
109	The cultivation of Ground nut. Leaflet No. 4.	Ditto.	Ditto.
110	Annual Report of the Department of Agriculture, Burma, for the year ending 30th June 1907.	Ditto.	Ditto.
111	Introduction of Moulmoin paddy into the Akyab District. Leaflet No. 6.	Ditto.	Ditto.
112	Annual Report of the Board of Scientific Advice for the year 1906-07. Price, Re. 1.	Board of Scientific Advice, Calcutta.	Government Printing India, Calcutta.
<i>Agricultural Chemistry</i>			
1	The Loss of Water from soil during dry weather. Price, Re. 2.	J. Walter Leather, Ph.D., F.R.S., Imperial Agricultural Chemist, Poona.	Memoirs of the Department of Agriculture, Vol. No. 6. Messrs. Thacker Spink & Co., Calcutta.
2	Official and Recommended methods for use in Chemical Laboratories of the Departments of Agriculture in India. Bulletin No. 8 of the Agricultural Research Institute, Poona. Price, annas 4.	Ditto.	Government Printing India, Calcutta.

* With Bengali and Assamese translations.

LIST OF AGRICULTURAL PUBLICATIONS DURING 1907-08.—(Continued).

No.	Title.	Author.	Where published.
<i>Agricultural Chemistry—concl.</i>			
	Annual Report of the Laboratory Work of the Agricultural Chemist of the Bombay Presidency. Price, annas 1.	Department of Agriculture, Bombay.	Government Central Press, Bombay.
	Report to the Government of India containing an account of the Research Work on Indigo performed in the University of Leeds, 1905-06. Price, 3 shillings.	W. Poppewell Bloxam, B.Sc. (Leeds), F.R.S., F.I.C.	Published by order of His Majesty's Secretary of State for India in Council.
	Report of Experiments to test the value of manures for crops in Behar.	J. W. Leather, Thib., F.I.C., F.R.S., Imperial Agricultural Chemist, Pusa; H. E. Annett, B.Sc., Supernumerary Chemist, Pusa, and W. Roberts, B.Sc., Supernumerary Agriculturist, Pusa.	Behar Planters' Association, Mazuferpore.
<i>Mycology.</i>			
	ungi India Orientalis, Part II.	E. J. Butler, M.B., F.R.S., in collaboration with H. Sydow.	Annales Mycologici, Vol. V, No. 6 of 1907.
	Report on trials of the South African Leaf-rot Fungus in India. Bulletin No. 5 of the Agricultural Research Institute, Pusa. Price, 2 annas.	E. J. Butler, M.B., F.R.S., Imperial Mycologist, Pusa, and H. Maxwell Leitch, M.A., F.R.S., F.I.C., Imperial Entomologist, Pusa.	Government Printing, India, Calcutta.
	Report on Coconut Palm Disease in Travancore. Bulletin No. 9 of the Agricultural Research Institute, Pusa. Price, 6 annas.	E. J. Butler, M.B., F.R.S., Imperial Mycologist, Pusa.	Ditto.
	Almyra Palm Disease in Godavari. Leaflet.	Ditto.	Ditto.
	Coconut Palm Disease in Travancore. Leaflet.	Ditto.	Ditto.
	Agave red rot in Burma. Leaflet.	Ditto.	Ditto.
	Orleans Mixture as a preventive of potato disease. Bulletin No. 19.	Rai Bahadur B. C. Basu, M.B.A.C., Assistant Director of Agriculture, E. B. & Assam.	Eastern Bengal and Assam Secretariat Press, Shillong.
	Note on the Orange Blight in the Khasi Hills. Leaflet.	Ditto.	Ditto.
	The Haustorium of Olax Scandens. Price, Rs. 28.	C. A. Barber, M.A., F.R.S., Government Botanist, Madras.	Memoirs of the Department of Agriculture in India, Botanical Series, Vol. II, No. 4, Messrs. Thacker, Spink & Co., Calcutta.

LIST OF AGRICULTURAL PUBLICATIONS DURING 1907-08—(Continued).

No.	TITLE.	Author.	Where published.
<i>Economic Botany.</i>			
1	Immune Wheats.	A. Howard, M.A., A.R.C.S., F.R.S., Imperial Economic Botanist, Pusa, (in collaboration with G. L. C. Howard.)	Journal of Agriculture Science, Vol. II, Part III 1907.
2	Some difficulties in Sugarcane Experiments.	A. Howard, M.A., A.R.C.S., F.R.S., Imperial Economic Botanist, Pusa.	International Sugar Journal, September 1907.
3	Notes on Agave and Foreera in India. Bulletin No. 8 of Bengal Department of Agriculture.	J. R. Drummond and D. Prain.	Bengal Secretariat Press, Calcutta.
4	The Indian Cottons. Price, Rs. 7.8.	G. A. Gammie, F.R.S., Economic Botanist to the Government of Bombay.	Memoirs of the Department of Agriculture, Vol. II, No. 2, Messrs. Thacker, Spink & Co.
5	Note on Toxic substance excreted by the roots of plants. Price, Re. 1.8.	F. Fletcher, M.A., B.Sc., Deputy Director of Agriculture.	Memoirs of the Department of Agriculture, Vol. II, No. 3, Messrs. Thacker, Spink & Co. Calcutta.
<i>Entomology.</i>			
1	The Mustard Saw-fly. Price, Re. 1.	H. Maxwell Lefroy, M.A., F.R.S., F.Z.S., Imperial Entomologist, Pusa, and C. C. Ghosh, B.A.	Memoirs of the Department of Agriculture, Vol. I, No. 6, Messrs. Thacker, Spink & Co. Calcutta.
2	The Rice Bug. Price, Re. 1.	Ditto.	Memoirs of the Department of Agriculture, Vol. II, No. 1, Messrs. Thacker, Spink & Co. Calcutta.
3	Remarks on Indian Scale Insects (coccidae) Part III. Price, Re. 1.8.	E. E. Green, F.R.S., F.Z.S., Government Entomologist, Ceylon.	Memoirs of the Department of Agriculture, Vol. II, No. 2, Messrs. Thacker, Spink & Co. Calcutta.
4	The Red Cotton Bug. Price, Rs. 2.	H. Maxwell Lefroy, M.A., F.R.S., F.Z.S., Imperial Entomologist, Pusa.	Memoirs of the Department of Agriculture, Vol. II, No. 3, Messrs. Thacker, Spink & Co. Calcutta.
5	The Castor Semi-looper. Price, Rs. 2.	Ditto.	Memoirs of the Department of Agriculture, Vol. II, No. 4, Messrs. Thacker, Spink & Co. Calcutta.
6	The Tobacco Caterpillar. Price, Re. 1.8.	Ditto.	Memoirs of the Department of Agriculture, India, Vol. II, No. 5, Messrs. Thacker, Spink & Co. Calcutta.
7	The Cotton Leaf Roller. Price, Re. 1.8.	Ditto.	Memoirs of the Department of Agriculture, India, Vol. II, No. 6, Messrs. Thacker, Spink & Co. Calcutta.
8	Ticks infesting domesticated animals in India. Bulletin No. 6 of the Agricultural Research Institute, Pusa. Price, annas 4.	C. Warburton, M.A., Zoologist to the Royal Agricultural Society of England.	Government Printing India, Calcutta.

LIST OF AGRICULTURAL PUBLICATIONS DURING 1907-08.—(Concluded).

No.	Title.	Author.	Where published.
<i>Entomology (continued).</i>			
9	A Preliminary Account of the Biting flies of India. Bulletin No. 7 of the Agricultural Research Institute, Pusa. Price, Re. 1.	H. Maxwell-Lefroy, M.A., F.R.S., F.Z.S., Imperial Entomologist, Pusa.	Government Printing, India, Calcutta.
10	Treatment and observation of Crop Pests on the Pusa Farm. Bulletin No. 10 of the Agricultural Research Institute Pusa. Price, As. 6.	H. Maxwell-Lefroy, M.A., F.R.S., F.Z.S., Imperial Entomologist, Pusa, and C. S. Misra, B.A., Assistant to the Imperial Entomologist, Pusa.	Ditto.
11	Chafers (P. Kyang Gaung and Chafers Grubs. Po Di Gaung). Leaflet No. 1.	Department of Agriculture, Burma.	Government Press, Burma, Rangoon.

PUBLICATIONS OF THE IMPERIAL DEPARTMENT OF AGRICULTURE IN INDIA.

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